

Report NVL-77-0270 ✓

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Searchlight Sets  
AN/VSS-4(XE-4)

Gordon R. Lavering

Varian Associates  
EIMAC Division  
301 Industrial Way  
San Carlos, California 94070

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Prepared For

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U.S. Army Electronics Command  
Fort Belvoir, Virginia 22060

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## 1.0 ABSTRACT

Two searchlight sets were designed, assembled, tested and delivered to the U.S. Army's Night Vision Laboratory. The searchlight is designed for installation within an armor tube mounted externally on the gun mantlet of various tanks

This report includes a description of the basic searchlight design and the results of electrical, optical and environmental tests performed on one of the searchlight sets.

## 2.0 PURPOSE

The purpose of this contract was to design, build and test two searchlight sets. The searchlights are high intensity (xenon arc lamp) systems capable of being encased in an armor shell for use on various combat vehicles.

### 3.0 DESCRIPTION

The searchlight set (AN/VSS-4(XE-4)) consists of three main units (see Figure 1). These are:

- Optical Unit
- Power Supply Unit
- Control Box Unit

Two interconnecting cables are also included:

- 17 foot cable (Power Supply to Optical Unit)
- 8 foot cable (Power Supply to Control Box)

#### 4.0 GLOSSARY

C.G.....	Center of Gravity
E.M.I.....	Electromagnetic Interference
L.V.S.....	Low Voltage Starting Arc Lamp (Refers to EIMAC X6257 Lamp)
Searchlight.....	Searchlight Set: AN/VSS-4(XE-4)
Stinger.....	The moveable electrode used in starting the L.V.S.

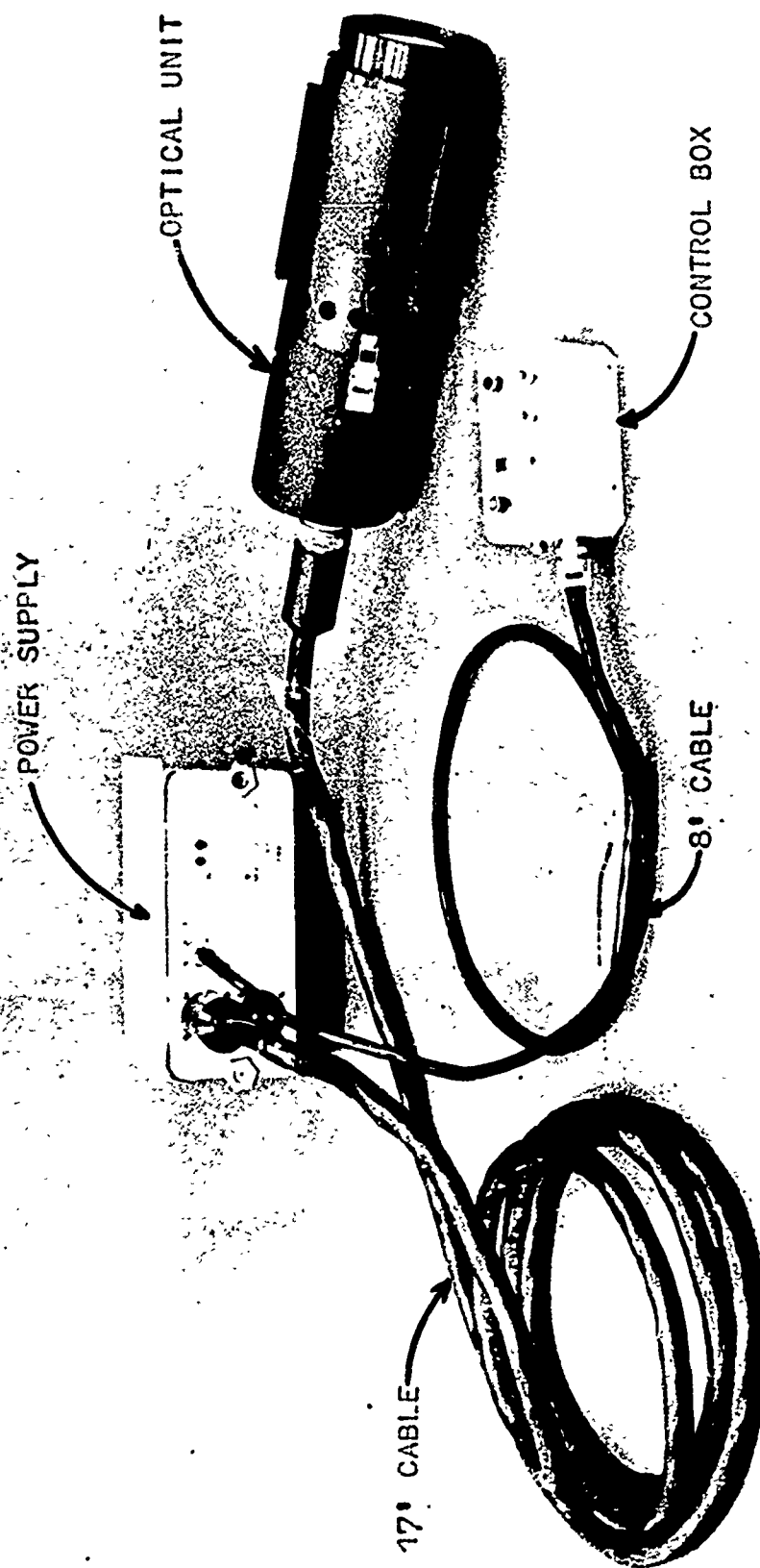


FIGURE 1: EIHAC SEARCHLIGHT SET AN/VSS-4(XE-4)

## 6.0 NARRATIVE AND DATA

One AN/VSS-4(XE-4) Searchlight Set was subjected to the quality assurance test sequence shown in Table I. The EIMAC quality assurance test procedure followed is included in Appendix I of this report.

The following sections of this report include a discussion of each test, sample test data, and notes on any test deviations or component failures which occurred .

TABLE I: TEST SEQUENCE FOR QUALITY ASSURANCE TESTING OF THE  
SEARCHLIGHT SET

EIMAC TEST PROCEDURE PARAGRAPH	TEST	TEST SEQUENCE
4.5.1	Starting & Normal Operation (24.0/28.0 VDC)	1, 4, 6, 8, 10, 12, 15,
4.5.2	Beam Characteristics	2, 13, 16
4.5.3	Low Temperature Storage (0 VDC)	3, 10, 11, 14,
4.5.4	High Temperature Storage (0 VDC)	5, 7, (in situ)
4.5.6	High Temperature Operation	9, (in situ)
4.5.5	Low Temperature Operation	11,
4.5.8	Vibration (Operating, 28.0 VDC)	14,
4.5.7	Shock (Operating, 23.0 VDC)	14,

## 6.1 Starting and Normal Operation Tests

Starting and Normal Operation Tests were conducted prior to exposure of the entire Searchlight Set (or Optical Unit only, as noted) to any of the required environmental tests. They were also repeated following each environmental test. A summary of the required operational checks are included in Table II. Additional operational checks were made several times during the environmental test period, and each will be noted in the discussion covering that particular test.

All starting and normal operation requirements were met during these tests except that the inrush current exceeded the allowable 60 ampere maximum when starting the searchlight at 28 VDC. The actual starting currents are shown in Figure 2.

The searchlight specification allows 3 seconds for ignition of the arc lamp. The actual time for ignition of the new EIMAC searchlight is typically less than 0.5 seconds.

All searchlight systems and mechanisms were working at both 24.0 and 28.0 VDC (including lamp starting in less than three seconds) when the searchlight was shipped to the customer.

TABLE II - SUMMARY OF REQUIRED STARTING AND NORMAL OPERATION TESTS

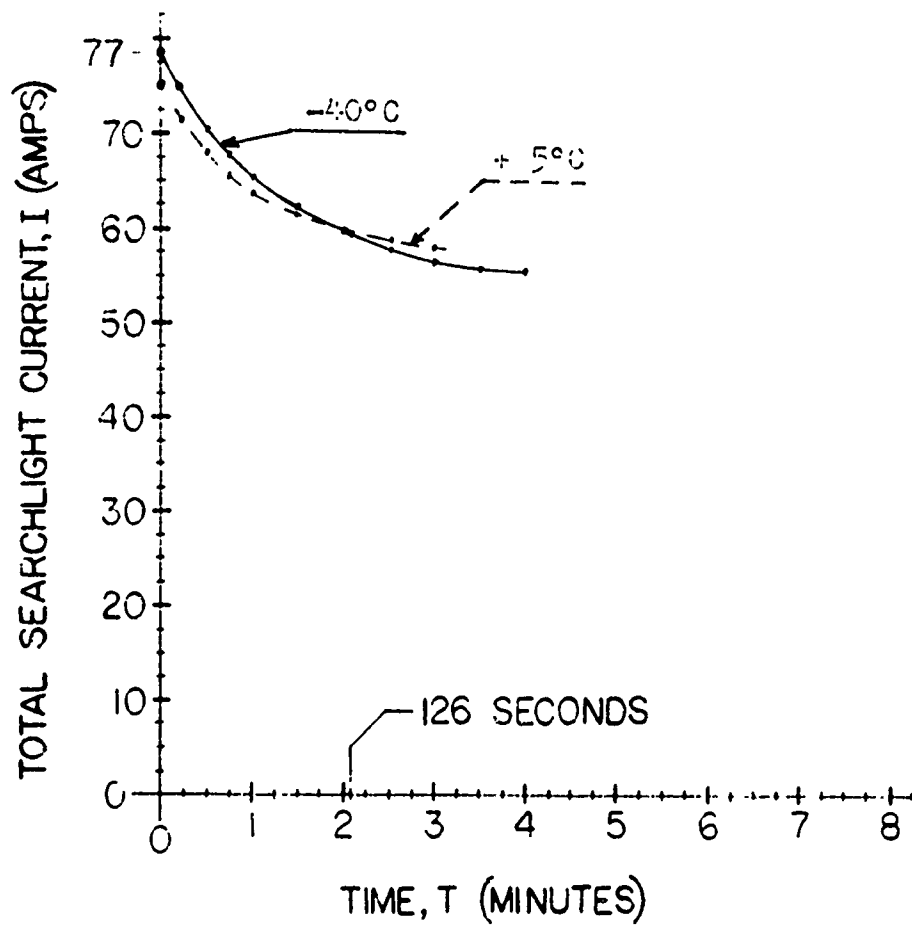
STARTING VDC   AMP	ARC LAMP <sup>1</sup> STARTS <3 SEC.	BLACKOUT ACTIVATES OPEN   CLOSE	I. R. FILTER ACTIVATES OPEN   CLOSE	SPREAD LENS ACTIVATES 2/60   6/20	REMARKS
28 > 60 <sup>2</sup>	Yes	Yes Yes	Yes Yes	Yes Yes	Pre-Quality Assurance Test
24 < 60	Yes	Yes Yes	Yes Yes	Yes Yes	
28 > 60 <sup>2</sup>	Yes	Yes Yes	Yes Yes	Yes Yes	Post-Low Temperature Storage
24 < 60	Yes	Yes Yes	Yes <sup>3</sup> Yes	Yes Yes	
28 > 60 <sup>2</sup>	Yes <sup>4</sup>	Yes Yes	Yes Yes	Yes Yes	Post-High Temperature Storage
24 < 60	Yes	Yes Yes	Yes Yes	Yes Yes	
28 > 60 <sup>2</sup>	Yes	Yes Yes	Yes Yes	Yes Yes	High Temperature Operation
24 < 60	Yes	Yes Yes	Yes Yes	Yes Yes	

TABLE II - SUMMARY OF REQUIRED STARTING AND NORMAL OPERATION TESTS

STARTING VDC   AMP	ARC LAMP <sup>1</sup> STARTS <3 SEC.	BLACKOUT ACTIVATES OPEN   CLOSE	I.R. FILTER ACTIVATES OPEN   CLOSE	SPREAD LENS ACTIVATES 2/60   6/20	REMARKS
28 > 60	Yes	<sup>5</sup> Yes	Yes	Yes	Low Temperature Operation
24 < 60	Yes	Yes	Yes	Yes	
28 > 60	Yes	Yes	Yes	<sup>6</sup> Yes	Post-Vibration
24 < 60	Yes	Yes	Yes	<sup>6</sup> Yes	
28 > 60	Yes	Yes	Yes	Yes	Post-Shock <sup>7</sup>
24 < 60	Yes	Yes	Yes	Yes	

#### Footnotes

1. The searchlight specification allows 3 seconds for ignition of the arc lamp. The actual time for ignition of the new EIMAC searchlight is typically less than 0.5 seconds.
2. When the searchlight is operating with 28 VDC input, the current in the searchlight decreases with slow warmup of the xenon arc lamp. Figure 2 is a plot of current vs time for ignition with the system temperature shown.
3. The I.R. filter did not open on the first attempt at 24 VDC. The searchlight was examined and the filter activating solenoid was found to have had an incorrect spring adjustment, this was corrected. The filter now activates at voltages as low as 20VDC.
4. The searchlight did not start on the first try at 28VDC. A connecting cable was found loose. It was tightened and the searchlight started on the next attempt.
5. The blackout filter appeared frozen shut, but opened slowly after the arc lamp had been ON for less than 0.5 minutes. This problem has been traced to frozen grease in the solenoid and has been resolved. See report text for explanation (Section 6.6).
6. The 20/60 spread lens retaining screws loosened during the last sweep of the vibration tests. The screws were re-inserted following the vibration tests and the 20/60 mechanism functioned.
7. Shock-induced damage occurred during testing. See the text (Section 6.8) for discussion.



IGNITION AND WARMUP CURRENT FOR 28 VDC OPERATION  
FIGURE 2

## 6.2 Beam Characteristics

The searchlight's beam data are shown in Figures 3,4, and 5.

The pre-qualification test data were recorded with arc lamp serial number A7E172 installed. In the compact beam mode, the beam was slightly off center. The beam was, however, essentially acceptable (see Figure 3). In the spread beam mode, the beam spread exceeded the  $7^{\circ}$  maximum allowed at the  $0^{\circ}$  polar position. It was less than the  $6^{\circ}$  minimum allowed at  $\pm 1^{\circ}$  polar angle.

The azimuthal and polar presentation of the searchlight's beam is a new requirement in the military searchlight program. Previous beam requirements have always been in terms of peak beam candlepower (P.B.C.) and beam spread at 10% of P.B.C. as measured by scanning through the P.B.C. point. The searchlights have always met the former requirements using the P.B.C. and 10% P.B.C. specifications. This new searchlight has the same lens system as previous searchlights.

Arc lamp A7E172 survived all the environmental tests except for intermittent sticking of the stinger to the lamp's cathode during shock. The spread lens in the searchlight was adjusted during the vibration tests. This is discussed later (Section 6.7) and some effect is noted in the Post-Vibration beam data (Figure 4).

Pre-Qualification test data indicated that the searchlight projected a beam of  $26.6 \times 10^6$  P.B.C. The Post-Vibration P.B.C. had dropped to  $20.4 \times 10^6$ . The minimum allowed is  $23 \times 10^6$ . Lamp A7E172 was a development lamp which had been assembled for investigating means for reducing electromagnetic interference (E.M.I.) in the EIMAC searchlight. (These investigations did prove that E.M.I. can be eliminated in the EIMAC searchlight.) This lamp incorporated four heat-daming slots in the anode.

## 6.2 Beam Characteristics/Continued

Post test inspection showed that hot gas exited these slots and discolored the arc lamp's reflector and, hence, reduced PBC.

Lamp A7E172 physically survived all of the environmental tests. During a post-test ignition sequence the arc lamp became a "leaker" and lost its xenon gas. Because of this, Post-Quality Assurance beam tests could not be conducted. A second lamp (A7E175) was installed in the searchlight and beam data were recorded (Figure 5). Although this beam data, too, is not totally within the specified requirements, it does show that the EIMAC searchlight's lens system is capable of surviving all of the imposed environmental tests.

A second means of presenting beam data was required in the program: the beam must fall within defined intensity and shape outlines. These data requirements are shown superimposed on sample data shown in Figures 6 through 17. These data are for both compact and spread beam modes in both polar and azimuthal scans.

The beam scan data show that arc lamp A7E172 met the Pre-Qualification Test compact mode beam shape requirements in both the azimuthal and polar scans (Figures 6 and 7). The edges of the beam were slightly wide in the azimuthal mode at the  $\pm 3\frac{1}{2}^\circ$  points when the searchlight was operating in the spread beam mode (Figure 8). It was within specified values in the polar scan, however, in the spread mode (Figure 9).

A slight adjustment of the spread lens position will correct the spread mode beam edge cut-off.

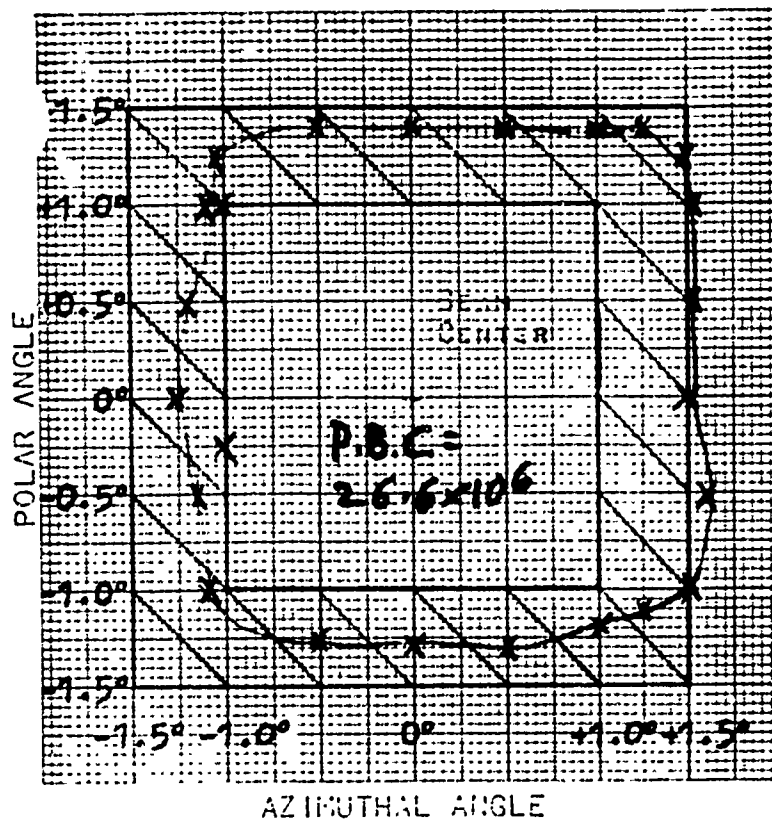
All of the above remarks apply to the Post-Vibration beam scan data (Figures 10 through 13) as well as the Post-Shock data (Figures 14 through 17).

TEST: PRE-QUAL TEST

31 JAN '77

ARC LAMP A7E172

ACCEPTABLE ZONES FOR EDGE  
OF BEAM PATTERN FOR COMPACT  
BEAM MODE AND SPREAD BEAM MODE  
(LOCUS OF POINTS AT 2% OF PEAK  
BEAM INTENSITY SHALL FALL WITHIN  
CROSS-HATCHED AREA)



SPREAD BEAM MODE

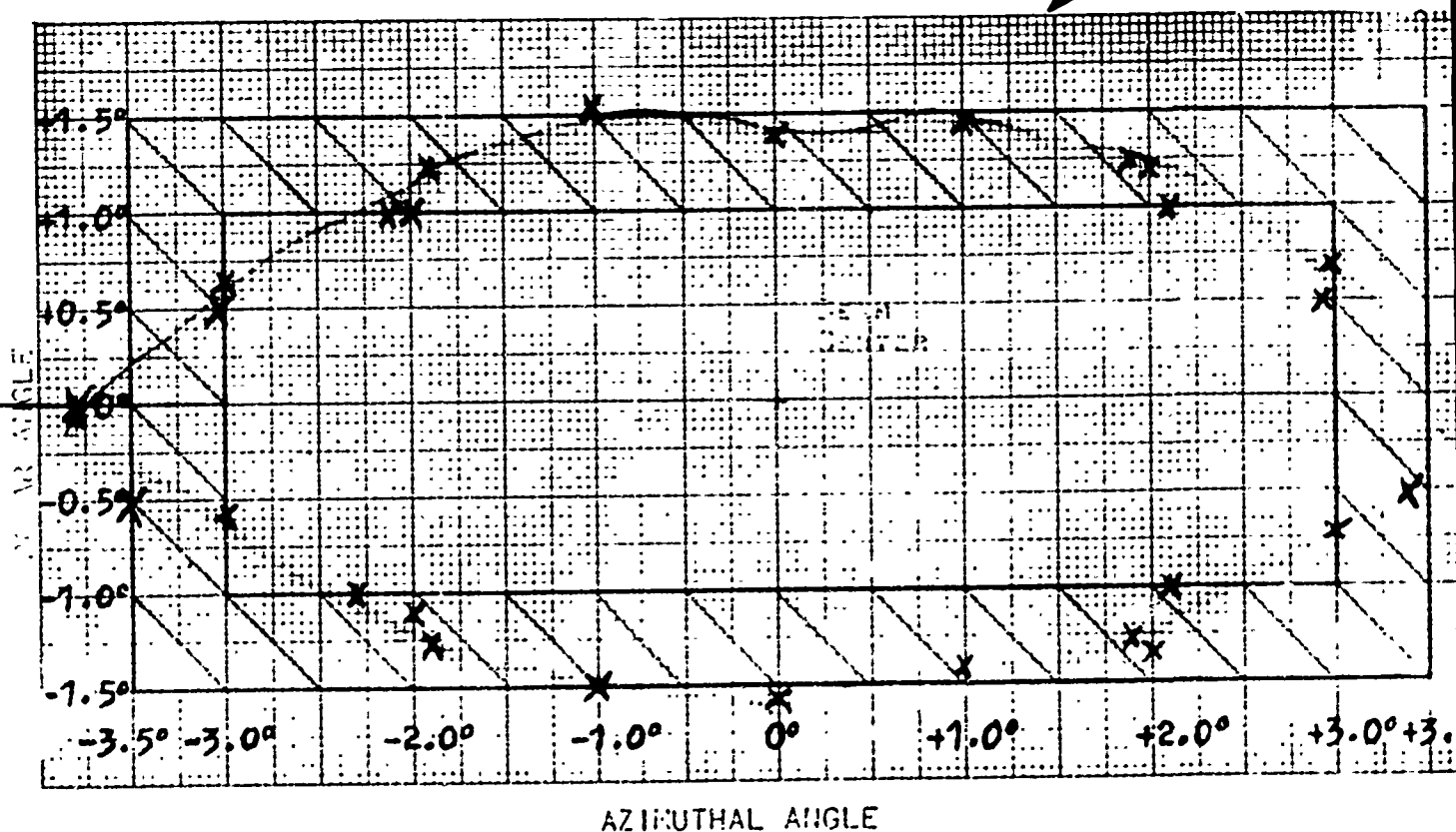
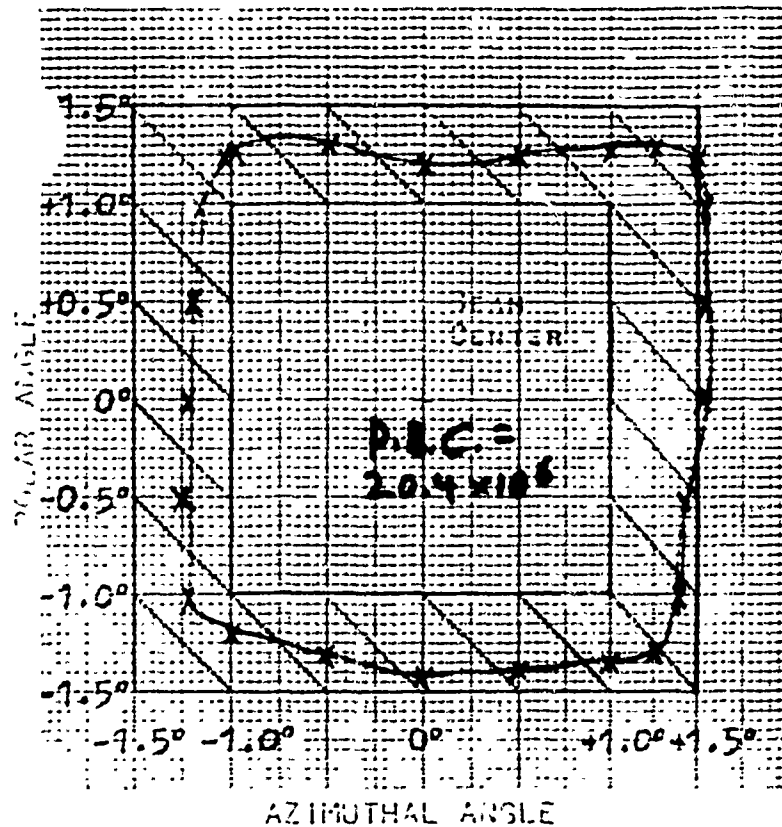


FIGURE 3

7 FEB 1977

# ARC LAMP A7E172

ACCEPTABLE ZONE FOR EDGE  
OF BEAM PATTERN FOR COMPACT  
BEAM MODE AND SPREAD BEAM MODE  
(LOCUS OF POINTS AT 2% OF BEAM  
INTENSITY SHALL FALL WITHIN  
CROSS-HATCHED AREA)



COMPACT BEAM MODE

SPREAD BEAM MODE

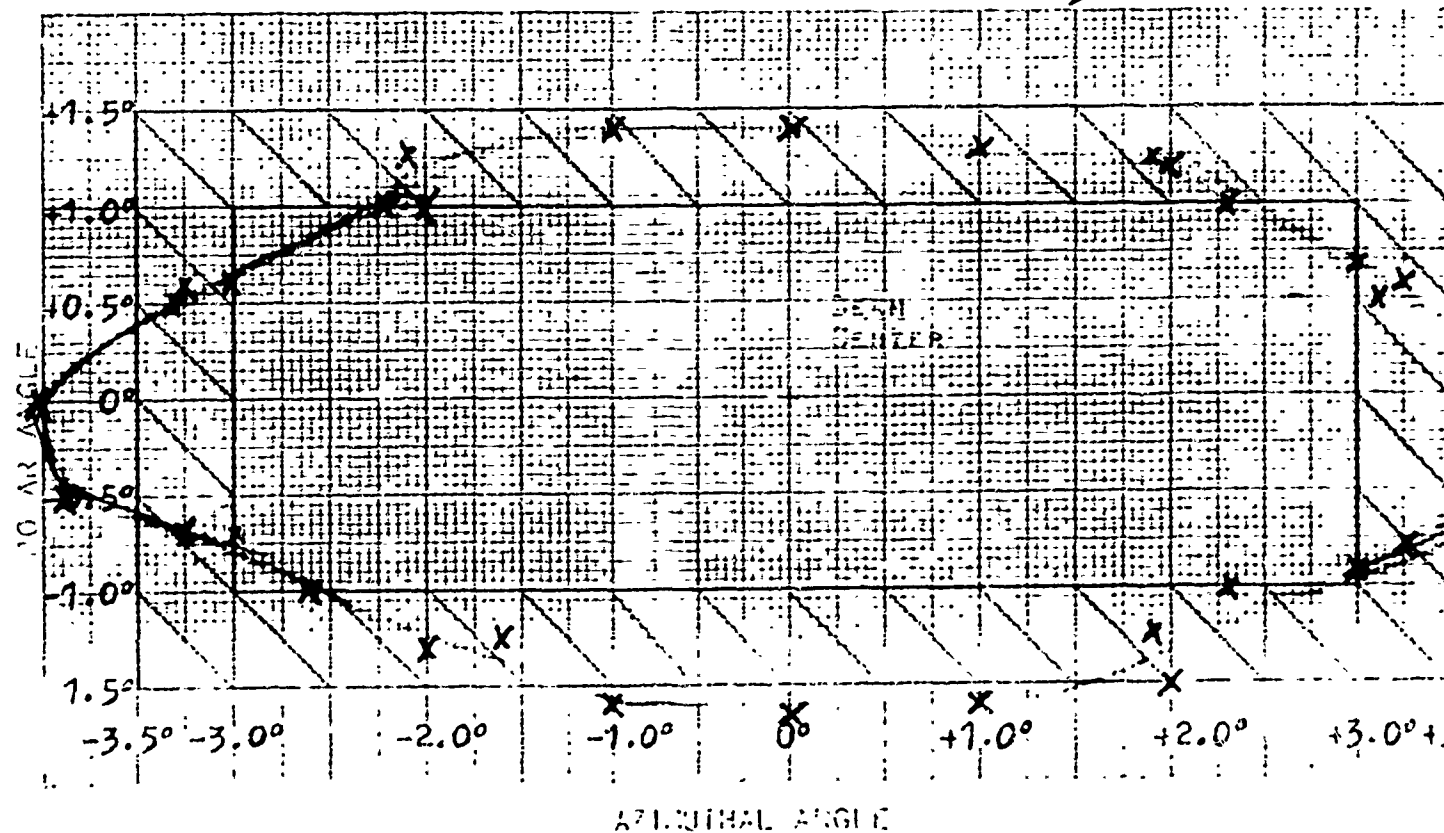
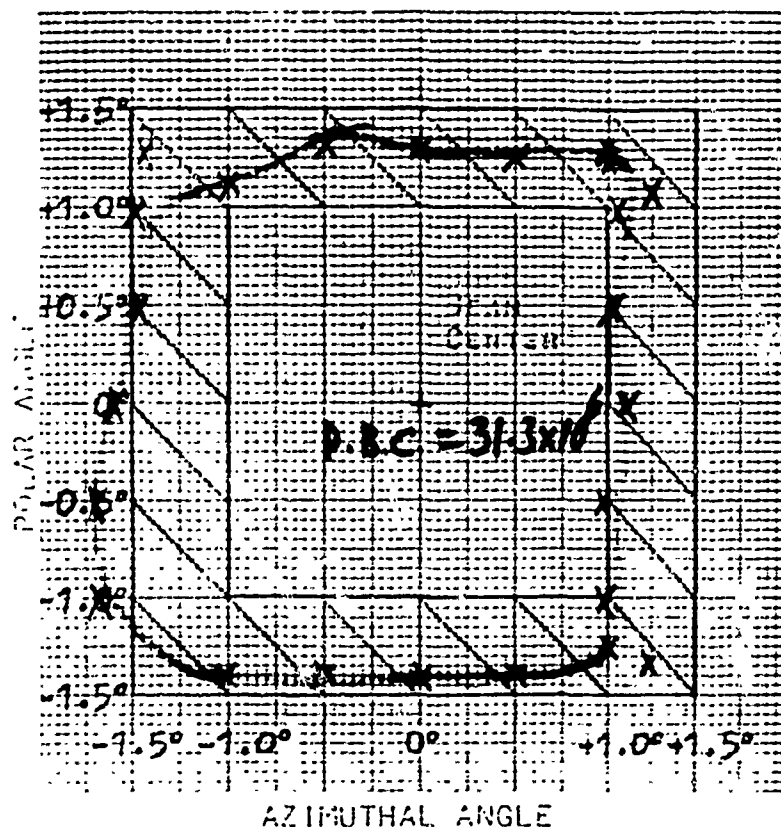


FIGURE 4

14. FEB '77  
ARC LAMP 7E175

ACCEPTABLE ZONES FOR EDGE  
OF BEAM PATTERN FOR COMPACT  
BEAM MODE AND SPREAD BEAM MODE  
(LOCUS OF POINTS AT 2% OF PEAK  
BEAM INTENSITY SHALL FALL WITHIN  
CROSS-HATCHED AREA)



SPREAD BEAM MODE

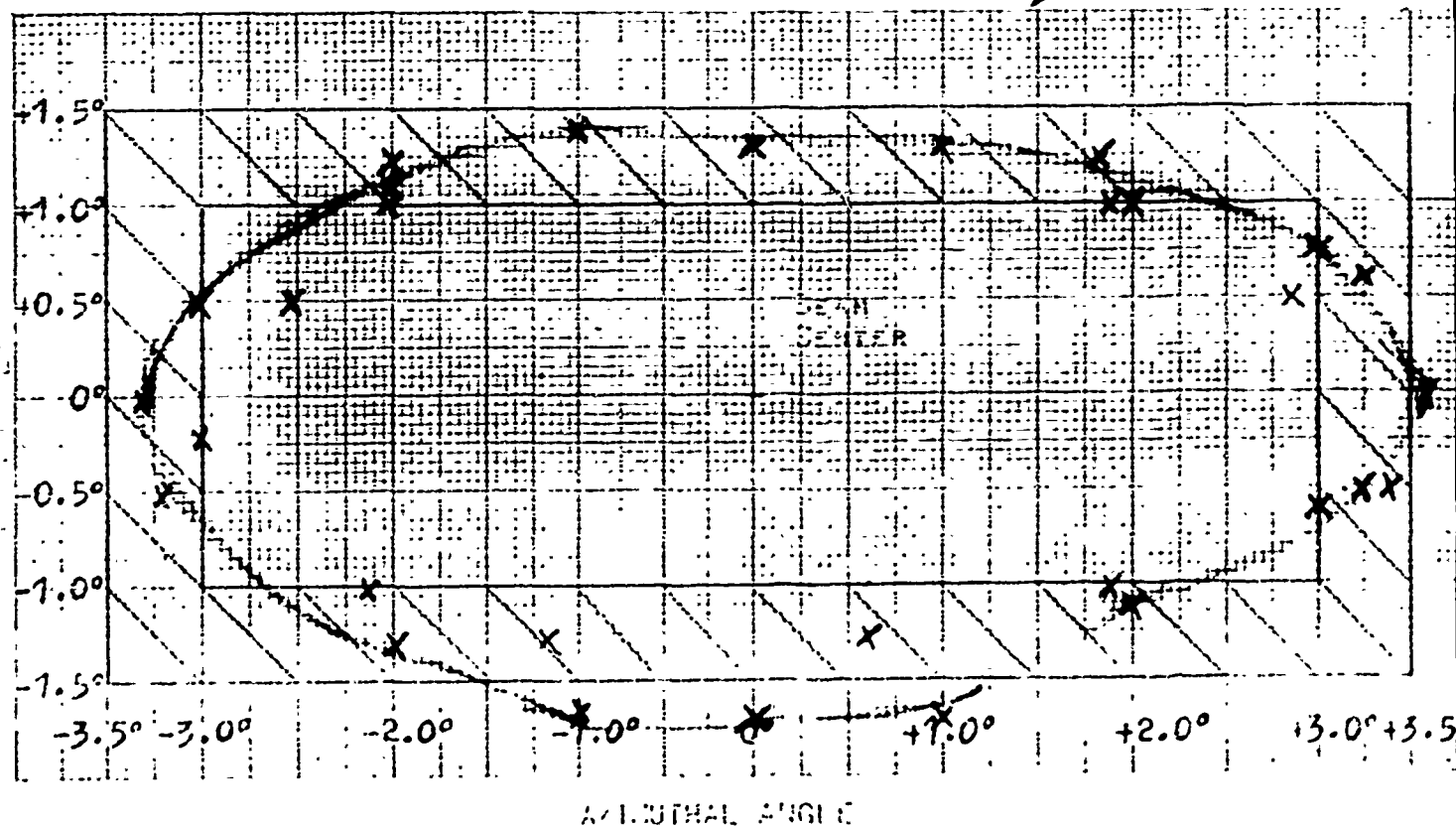


FIGURE 5

# PHOTOMETRIC TEST FORM

Lamp Type: Silver  
 Ceramic #: Alum  
 Serial No.: A7E172

Peak Beam Candpower (PBC)  
 Calib. 63.0/60.6 oh scale  
 Calib. Corr. (CC)  
 Scale Factor (SF)  
 Test Lamp (TL)  
 PBC = 5,910 x CC x SF x TL = K  
 PBC = 59,130 x CC x SF x TL = K

Age

Total

NVL #1  
A2 L  
± 0.0 COMP.

TEST REF: ILLUMINATION

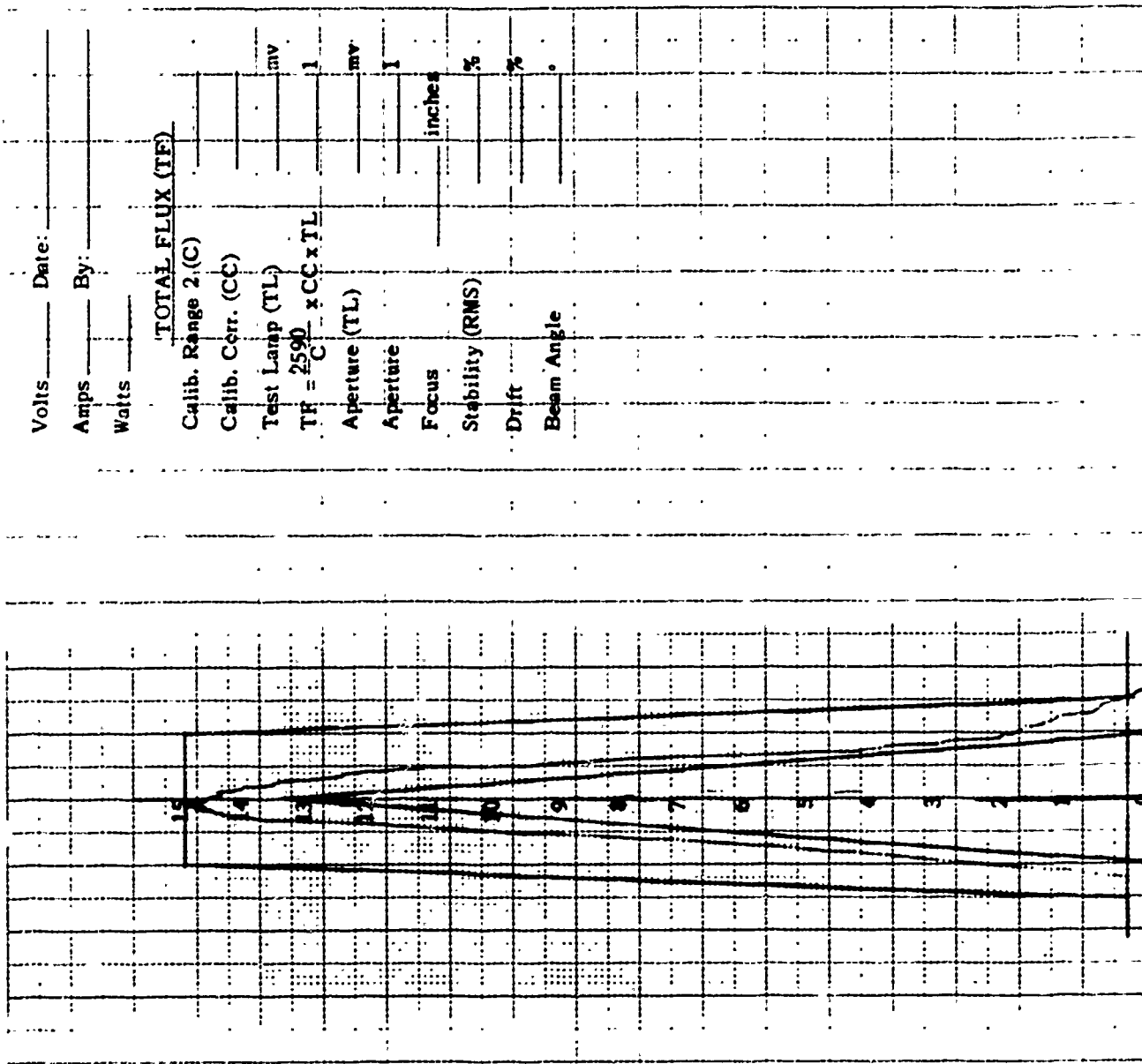
DATE: 31 JAN 1977

BEAM CONFIGURATION: COMPACT

SCAN: ZENITH

PBC: 5,910

FIGURE: 6



Volts: \_\_\_\_\_ Date: \_\_\_\_\_  
 Amps: \_\_\_\_\_ By: \_\_\_\_\_  
 Watts: \_\_\_\_\_  
 TOTAL FLUX (TF)  
 Calib. Range 2 (C)  
 Calib. Corr. (CC)  
 Test Lamp (TL)  
 TF =  $\frac{2590}{C} \times CC \times TL$   
 Aperture (TL)  
 Aperture  
 Focus \_\_\_\_\_ inches  
 Stability (RMS)  
 Drift  
 Beam Angle

LMP-104

# PHOTO-ETRIC TEST FORM

Lamp Type Silver  
 Ceramic # Alum.  
 Serial No. A7E172

## Peak Beam Candlepower (PBC)

Calib. 63.0/60.6 on scale  
 Calib. Corr. (CC)           
 Scale Factor (SF)           
 Test Lamp (TL)          mv  
 PBC = 5, 910 x CC x SF x TL =          K  
 PBCi = 59, 130 x CC x SF x TL =          K

Age          Total         

NVL #1  
POL L  
± 0.0 comp.

TEST QUALIFICATION

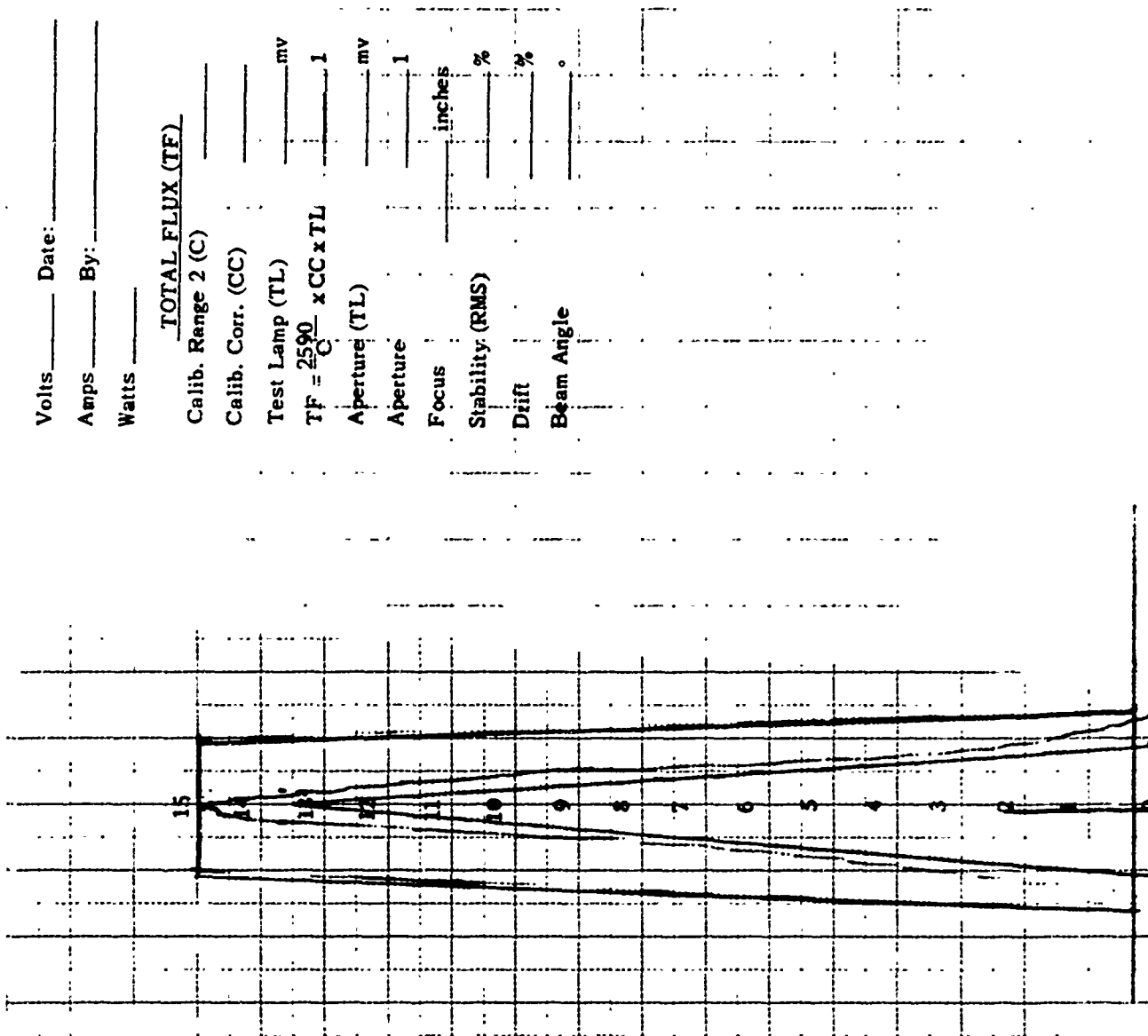
DATE 3 JAN 1977

BEAM CONFIGURATION: COMPACT

SCAN POLAR

PBC 5.0 x 10<sup>3</sup>

FIGURE 7



Volts          Date:           
 Amps          By:           
 Watts         

## TOTAL FLUX (TF)

Calib. Range 2 (C)           
 Calib. Corr. (CC)           
 Test Lamp (TL)          mv  
 TF =  $\frac{2590}{C} \times CC \times TL$           1  
 Aperture (TL)          mv  
 Aperture          1  
 Focus          inches  
 Stability (RMS)          %  
 Drift          %  
 Beam Angle          °

LMP-104

461510

# PHOTO METRIC TEST FORM

Lamp Type Silver  
 Ceramic # Alum  
 Serial No. A7E172

## Peak Beam Candlepower (PBC)

Calib. 63.0/60.6 on scale  
 Calib. Corr. (CC) \_\_\_\_\_  
 Scale Factor (SF) \_\_\_\_\_  
 Test Lamp (TL) \_\_\_\_\_  
 PBC =  $5,910 \times CC \times SF \times TL$  = \_\_\_\_\_ K  
 PBC =  $59,130 \times CC \times SF \times TL$  = \_\_\_\_\_ K

Age \_\_\_\_\_ Total \_\_\_\_\_

NVL #1  
 A2 ✓  
 ± 0 0 SPREAD

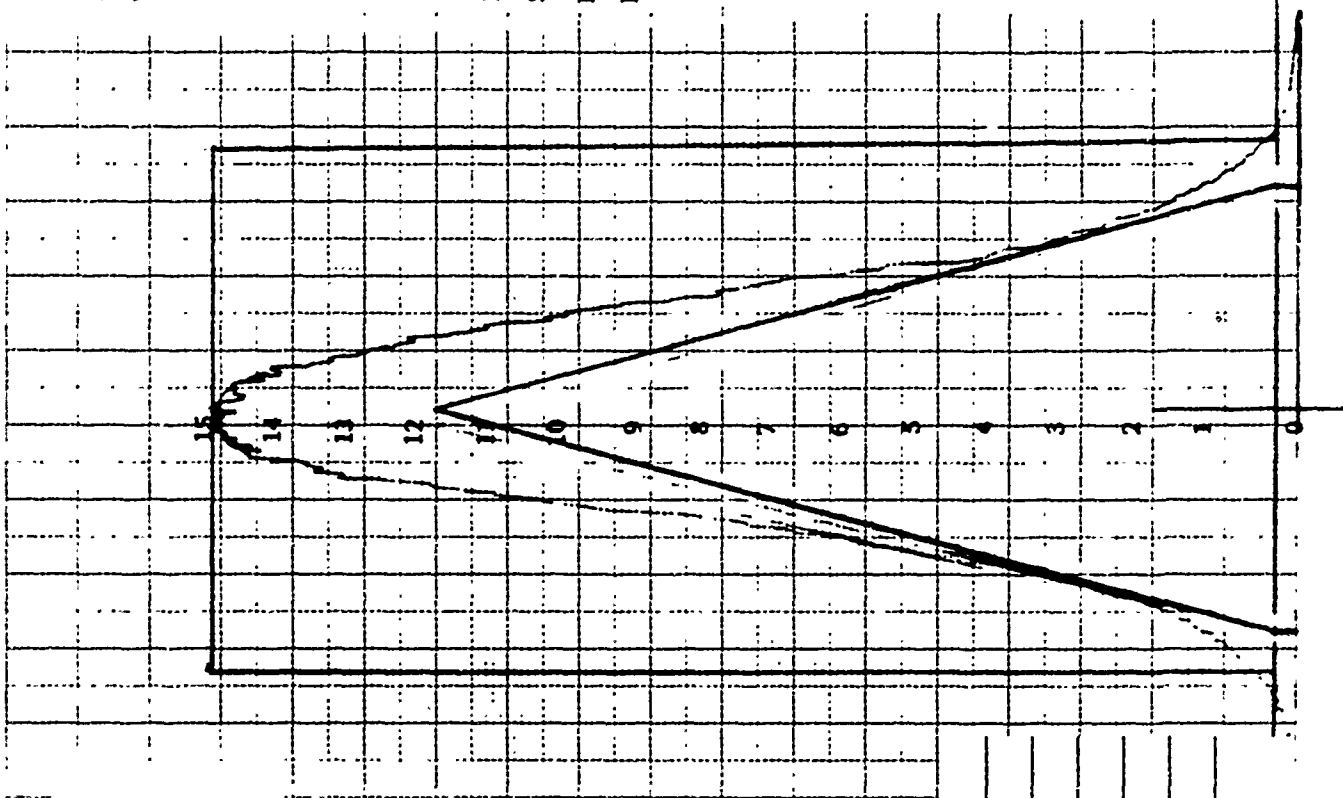
## TEST PRE-ALIGNMENT

DATE: 31 JAN 1977  
 BEAM CONFIGURATION: SPREAD  
 SCAN: ZIMUTH  
 P.B.C. \_\_\_\_\_  
 FIGURE: 8

Volts \_\_\_\_\_ Date: \_\_\_\_\_  
 Amps \_\_\_\_\_ By: \_\_\_\_\_  
 Watts \_\_\_\_\_

## TOTAL FLUX (TF)

Calib. Range 2 (C) \_\_\_\_\_  
 Calib. Corr. (CC) \_\_\_\_\_  
 Test Lamp (TL) \_\_\_\_\_  
 TF =  $\frac{2590}{C} \times CC \times TL$  \_\_\_\_\_ mv  
 Aperture (TL) \_\_\_\_\_  
 Aperture \_\_\_\_\_  
 Focus \_\_\_\_\_ inches  
 Stability (RMS) \_\_\_\_\_ %  
 Drift \_\_\_\_\_ %  
 Beam Angle \_\_\_\_\_ °



LMP-104

PHOTO-ELECTRIC TEST FORM

Lamp Type: Silver  
 Ceramic #: Alum  
 Serial No. A7E172

Peak Beam Candlepower (PBC)

Calib. 63.0/60.0 on scale

Calib. Corr. (CC)

Scale Factor (SF)

Test Lamp (TL) mv

PBC =  $5,910 \times CC \times SF \times TL$  = K

PBC =  $59,130 \times CC \times SF \times TL$  = K

Age

Total

Nu 4 41

Pov 4

± 0.0 spread

TEST: PBC - VALIDATION

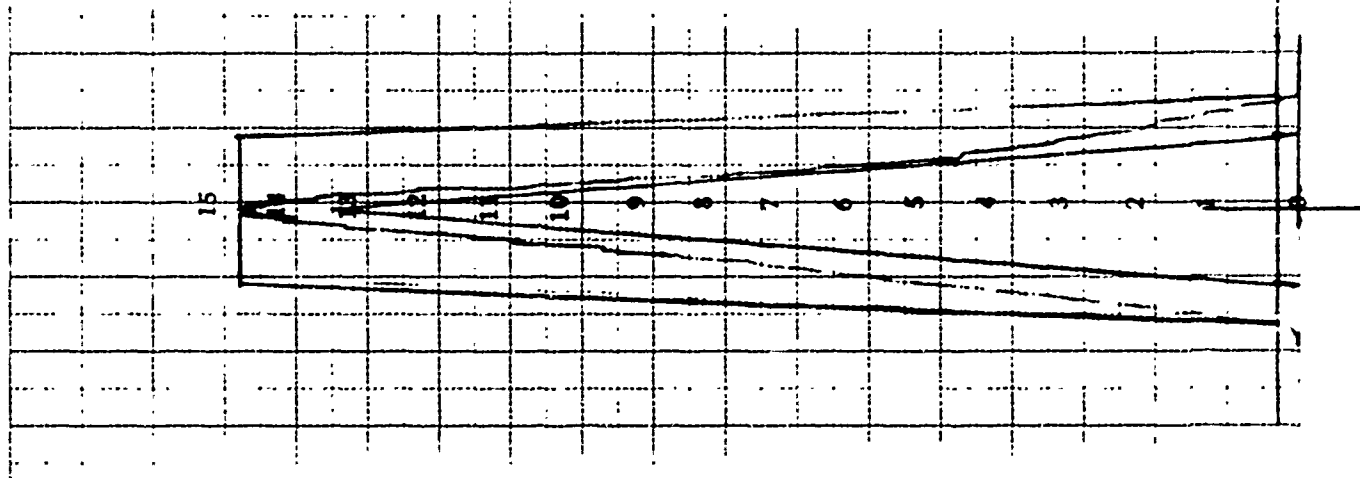
DATE: 21 JAN 1977

BEAM CONFIGURATION: SPREAD

SCAN: POLAR

P.B.C.:

FIGURE: 9



Volts: Date:  
 Amps: By:  
 Watts:

TOTAL FLUX (TF)

Calib. Range 2 (C)

Calib. Corr. (CC)

Test Lamp (TL)

TF =  $\frac{2590}{C} \times CC \times TL$

Aperture (TL)

Aperture

Focus inches

Stability (RMS)

Drift

Beam Angle

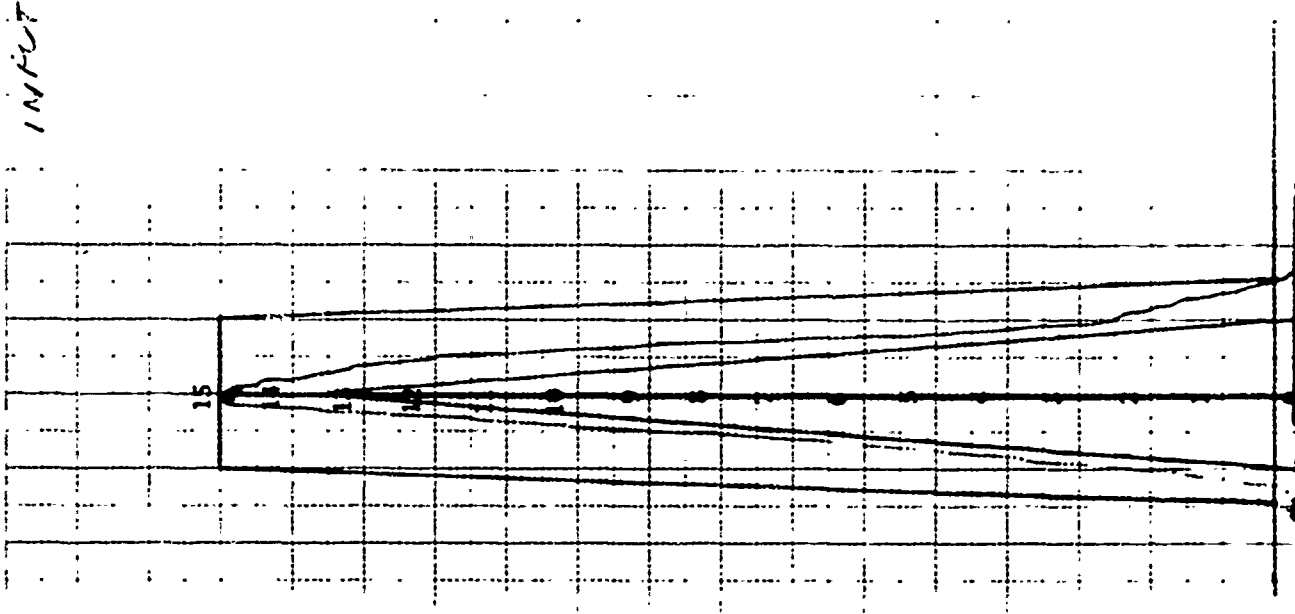
# PHOTOMETRIC TEST FORM

Lamp Type Silver  
 Ceramic # Alum  
 Serial No. AZE-172

Peak Beam Candlepower (PBC)  
 Calib. 63.0/60.6 on scale  
 Calib. Corr. (CC)  
 Scale Factor (SF)  
 Test Lamp (TL) 55.8 mv  
 PBC 59.10 CC x SF x TL K  
 PBC 59.130 CC x SF x TL = K

Age Total  
VVL #1  
AZ172  
± 0° 0' COMPACT

TEST NAME-VARIATION  
 DATE Feb 1977  
 BEAM CONFIGURATION: COMPACT  
 SCAN 121MUTH  
 PBC 20.4x10  
 FIGURE: 10



Volts 280 Date 2.7.77  
 Amps By:  
 Watts

TOTAL FLUX (TF)  
 Calib. Range 2 (C)  
 Calib. Corr. (CC)  
 Test Lamp (TL) mv  
 TF = 2590 x CC x TL 1  
 Aperture (TL) mv  
 Aperture I  
 Focus inches  
 Stability (RMS) %  
 Drift %  
 Beam Angle °

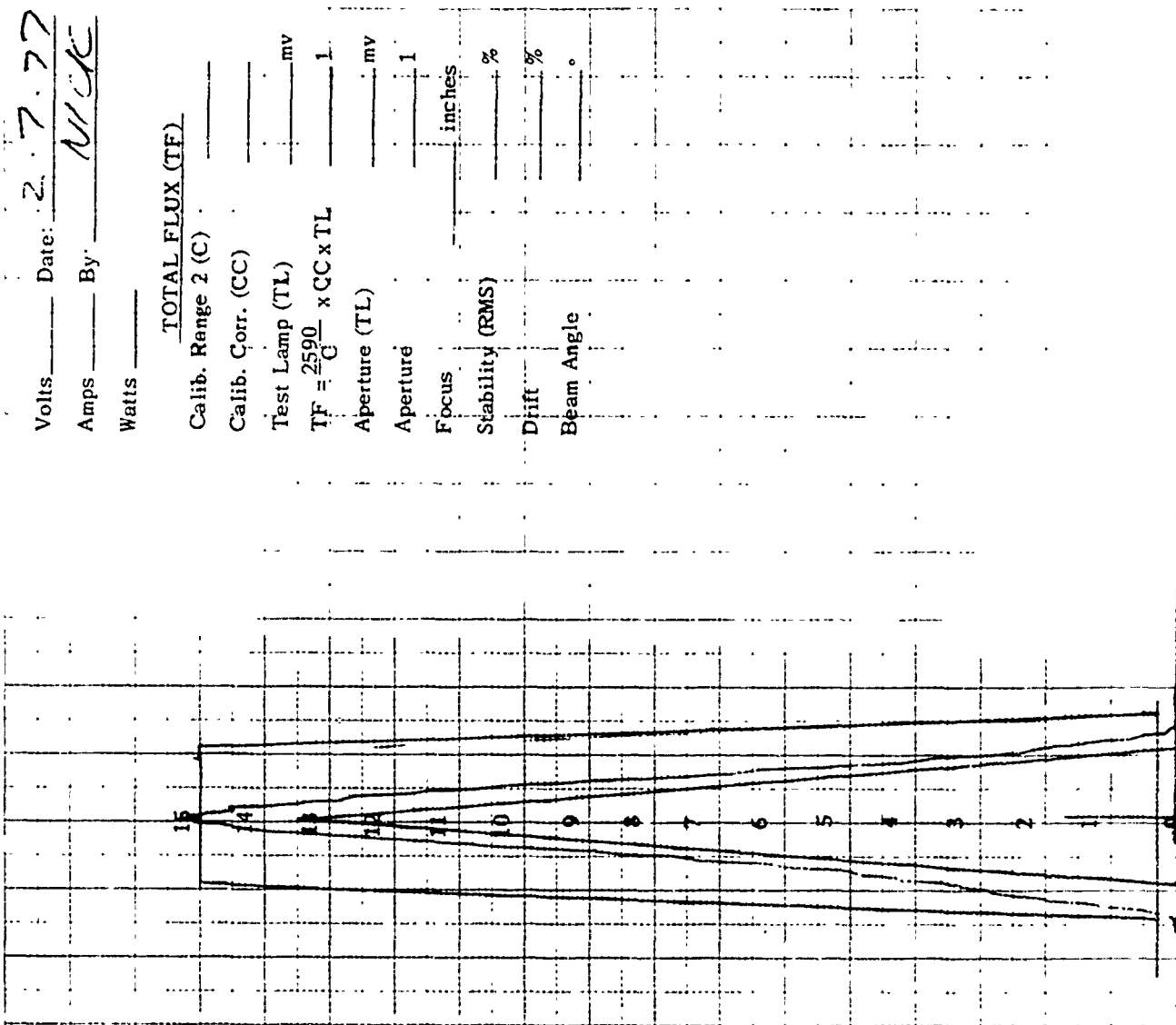
# PHOTO-ETRIC TEST FORM

Lamp Type Silver  
 Ceramic # Alum  
 Serial No. A7E172

Peak Beam Candlepower (PBC)  
 Calib. 63.0/60.6 on scale  
 Calib. Corr. (CC)  
 Scale Factor (SF)  
 Test Lamp (TL) 345 mv X  
 PBC = 5, 910 ~~CC~~ x SF x TL = K  
 PBC 59, 130 x CC x SF x TL = 20.4 x 10<sup>6</sup> ppc

Age Total  
NVL A1  
POL L  
± 0° 0' Comp.

TEST. LIGHT-VIBRATION  
 DATE 7 FEB 1977  
 BEAM CONFIGURATION: COMPACT  
 SCAN: POLAR  
 PBC: 20.4 x 10<sup>6</sup>  
 FIGURE 11



Volts 2.7.77  
 Date: 2.7.77  
 Amps NICK  
 By: NICK  
 Watts  
 TOTAL FLUX (TF)  
 Calib. Range 2 (C)  
 Calib. Corr. (CC)  
 Test Lamp (TL)  
 TF =  $\frac{2590}{C} \times CC \times TL$   
 Aperture (TL)  
 Aperture  
 Focus  
 Stability (RMS)  
 Drift  
 Beam Angle

# PHOTOMETRIC TEST FORM

Lamp Type Silver  
 Ceramic # Alum  
 Serial No. A7E172  
 Peak Beam Candlepower (PBC) \_\_\_\_\_  
 Calib. 63.0/60.6 on scale \_\_\_\_\_  
 Calib. Corr. (CC) \_\_\_\_\_  
 Scale Factor (SF) \_\_\_\_\_  
 Test Lamp (TL) \_\_\_\_\_ mv  
 PBC = 5,910 x CC x SF x TL = \_\_\_\_\_ K  
 PBC = 59,130 x CC x SF x TL = \_\_\_\_\_ K

Age \_\_\_\_\_ Total \_\_\_\_\_

NVL  
A2  
+ 0° 0' spread

TEST CONFIGURATION

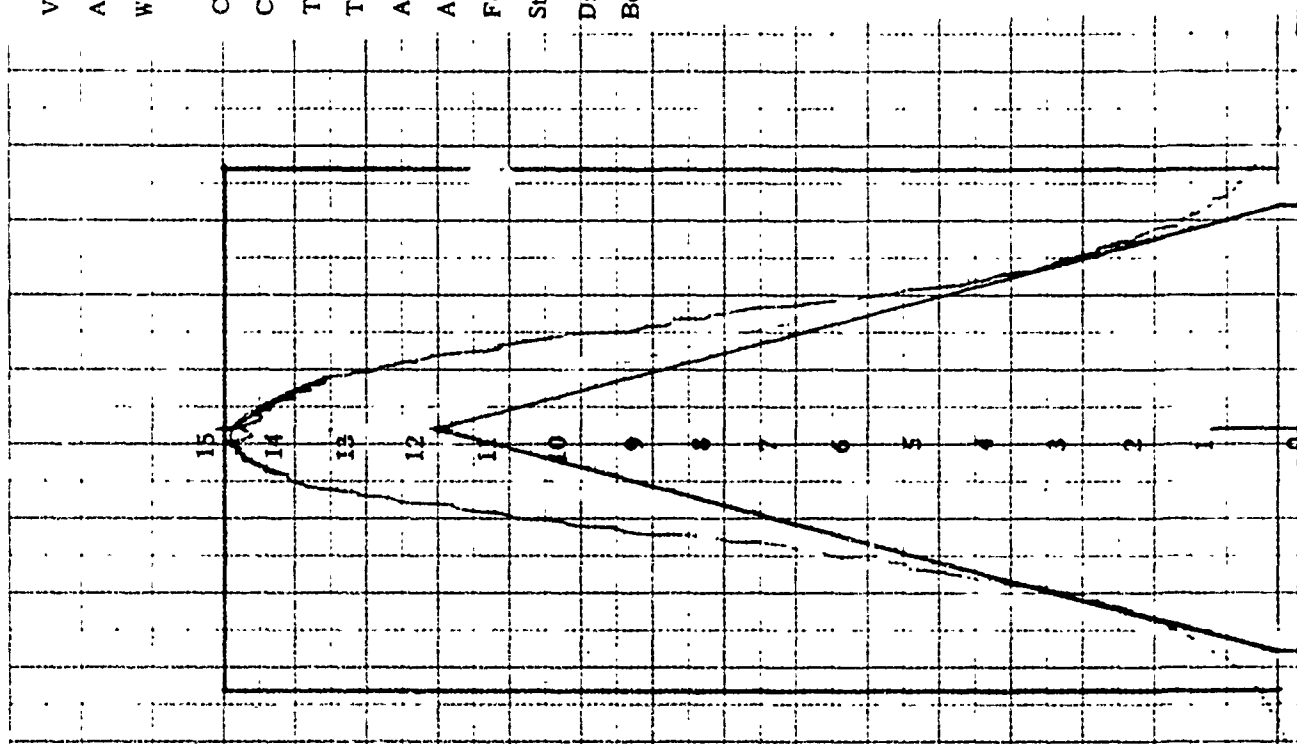
DATE 7 FEB 1972

BEAM CONFIGURATION READ

SCAN ZINUTH

PBC \_\_\_\_\_

FIGURE 12



Volts \_\_\_\_\_ Date \_\_\_\_\_  
 Amps \_\_\_\_\_ By \_\_\_\_\_  
 Watts \_\_\_\_\_

TOTAL FLUX (TF)

Calib. Range 2 (C) \_\_\_\_\_

Calib. Corr. (CC) \_\_\_\_\_

Test Lamp (TL) \_\_\_\_\_ mv

TF =  $\frac{2590}{C} \times CC \times TL$  \_\_\_\_\_ 1

Aperture (TL) \_\_\_\_\_ mv

Aperture \_\_\_\_\_ 1

Focus \_\_\_\_\_ inches

Stability (RMS) \_\_\_\_\_ %

Drift \_\_\_\_\_ %

Beam Angle \_\_\_\_\_ °

LMP-104

461510

10 X 10 TO THE CENTIMETER  
 MICROLIGHT RADIATION

# PHOTOETRIC TEST FORM

Lamp Type \_\_\_\_\_ Silver \_\_\_\_\_  
 Coating \_\_\_\_\_ Alum \_\_\_\_\_  
 Serial No. A7E172  
 Peak Beam Candlepower (PBC) \_\_\_\_\_  
 Calib. 0.0 60.0 on scale \_\_\_\_\_  
 Calib. Corr. (CC) \_\_\_\_\_  
 Scale Factor (SF) \_\_\_\_\_  
 Test Lamp (TL) \_\_\_\_\_ mv  
 PBC 5, 910 x CC x SF x TL = \_\_\_\_\_ K  
 PBC 59, 130 x CC x SF x TL = \_\_\_\_\_ K

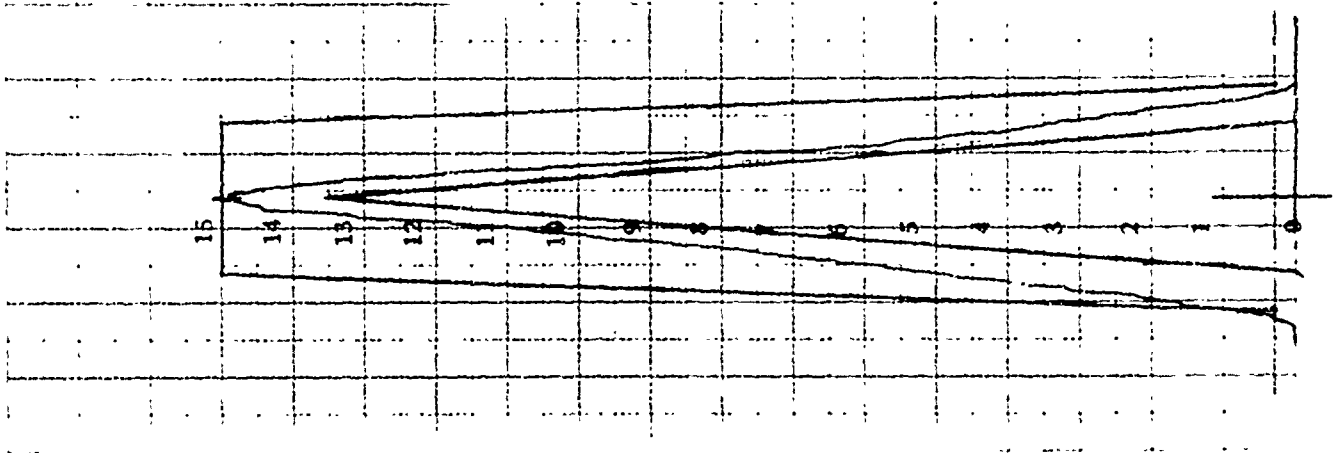
Age \_\_\_\_\_ Total \_\_\_\_\_

NVL #1

Rev L

f 0° 0' spread

TEST J-11: TLN  
 DATE Feb 77  
 BEAM CONFIGURATION SPREAD  
 SCAN POLAR  
 PBC  
 FIGURE 13



Volts \_\_\_\_\_ Date \_\_\_\_\_  
 Amps \_\_\_\_\_ By \_\_\_\_\_  
 Watts \_\_\_\_\_  
 TOTAL FLUX (TF) \_\_\_\_\_  
 Calib. Range 2 (C) \_\_\_\_\_  
 Calib. Corr. (CC) \_\_\_\_\_  
 Test Lamp (TL) \_\_\_\_\_ mv  
 TF =  $\frac{2590}{C} \times CC \times TL$  \_\_\_\_\_ 1  
 Aperture (TL) \_\_\_\_\_ mv  
 Aperture \_\_\_\_\_ 1  
 Focus \_\_\_\_\_ inches  
 Stability (RMS) \_\_\_\_\_ %  
 Drift \_\_\_\_\_ %  
 Beam Angle \_\_\_\_\_ °

LMP-104

4C1510

# PHOTOMETRIC TEST FORM

Lamp Type Silver  
 Ceramium # Alum  
 Serial No. A7E125  
 Peak Beam Candlepower (PBC)  
 Calib. 63.0 60.6 on scale  
 Calib. Corr. (CC)         
 Scale Factor (SF) 54.0<sub>mv</sub>  
 Test Lamp (TL)         
 PBC = 5.910 x CC x SF x TL =        K  
 PBC = 59.130 x CC x SF x TL = 3193 K

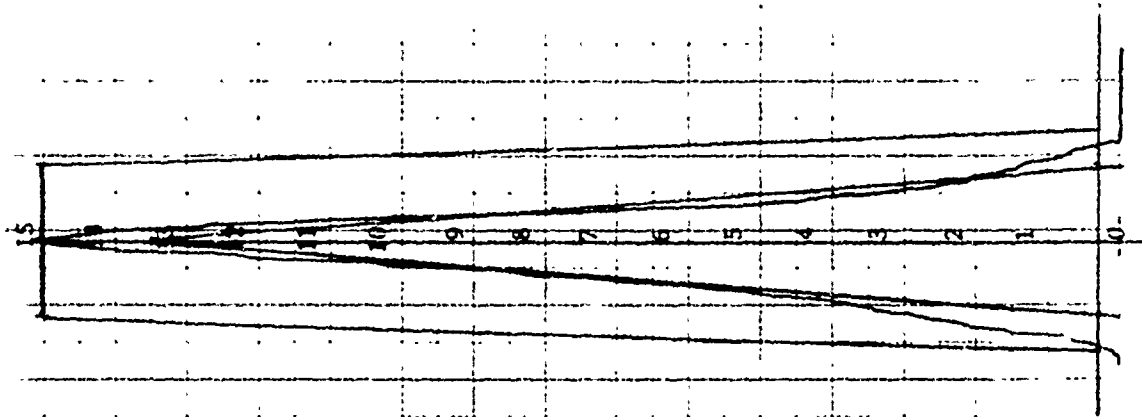
Age        Total       

NVL #1  
AZ L  
± 0° 0' comp.

TEST POINT - CHECK  
 DATE: 14 FEB 1977  
 BEAM CONFIGURATION: COMPACT  
 SCAN: AZIMUTH  
 PBC: 3193  
 FIGURE 14

INPUT Volts 28 Date 2.14.77  
 Amps        By: U/LK  
 Watts       

TOTAL FLUX (TF)  
 Calib. Range 2 (C)         
 Calib. Corr. (CC)         
 Test Lamp (TL)        mv  
 TF = 2590 / C x CC x TL 1  
 Aperture (TL)        mv  
 Aperture 1  
 Focus        inches  
 Stability (RMS)        %  
 Drift        %  
 Beam Angle        °



LMP-104

PHOTO-ELECTRIC TEST FORM

Lamp Type Silver  
 Ceramic # Alum  
 Serial No. A7612J

Peak Beam Candlepower (PBC)  
 Calib. 63.0/60.6 on scale  
 Calib. Corr. (CC)  
 Scale Factor (SF) 53.0 mv  
 Test Lamp (TL)  
 PBC = 5.010 \* CC \* SF \* TL = K  
 PBC = 59.130 x CC x SF x TL = 31338

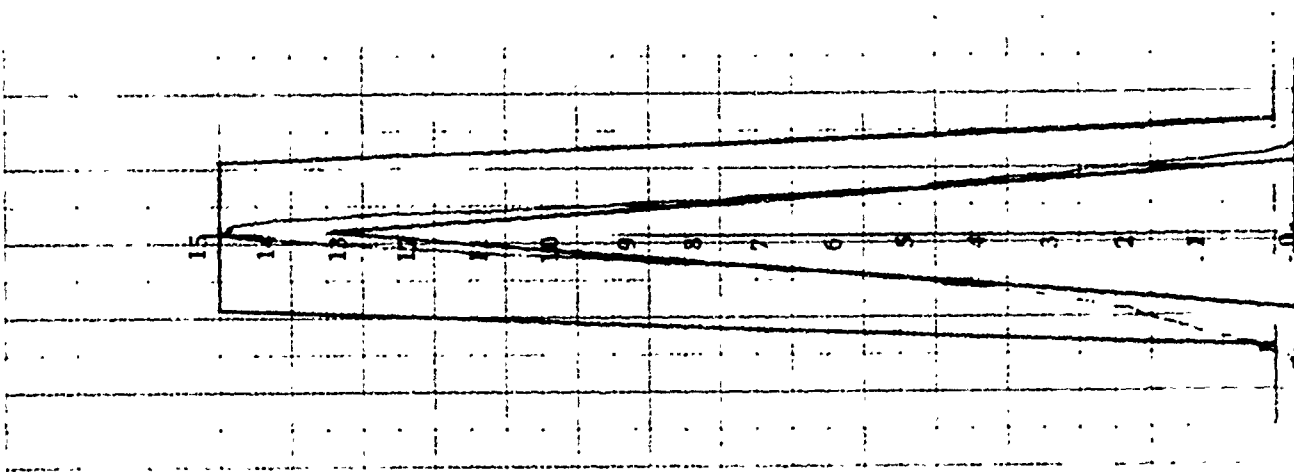
Age            Total           

NVL #1  
 Polar <  
 ± 0° 0' compass

TEST POUT-ALOK  
 DATE 14 FEB 1977  
 BEAM CONFIGURATION: COMPACT  
 SCAN: 100°  
 PBC: 31338  
 FIGURE 45

INPUT Volts 280 Date 2 14. 77  
 Amps            By: WICK  
 Watts           

TOTAL FLUX (TF)  
 Calib. Range 2 (C)  
 Calib. Corr. (CC)  
 Test Lamp (TL)  
 TF = 2590 x CC x TL  
 Aperture (TL)  
 Aperture  
 Focus            inches  
 Stability (RMS)  
 Drift  
 Beam Angle



LMP-104

# PHOTOMETRIC TEST FORM

Lamp Type      Silver       
 Ceramic #      Alum       
 Serial No. A 26125

Peak Beam Candlepower (PBC)

Calib. 63.0/60.0 on scale       
 Calib. Corr. (CC)       
 Scale Factor (SF) 16.3 mv  
 Test Lamp (TL)     

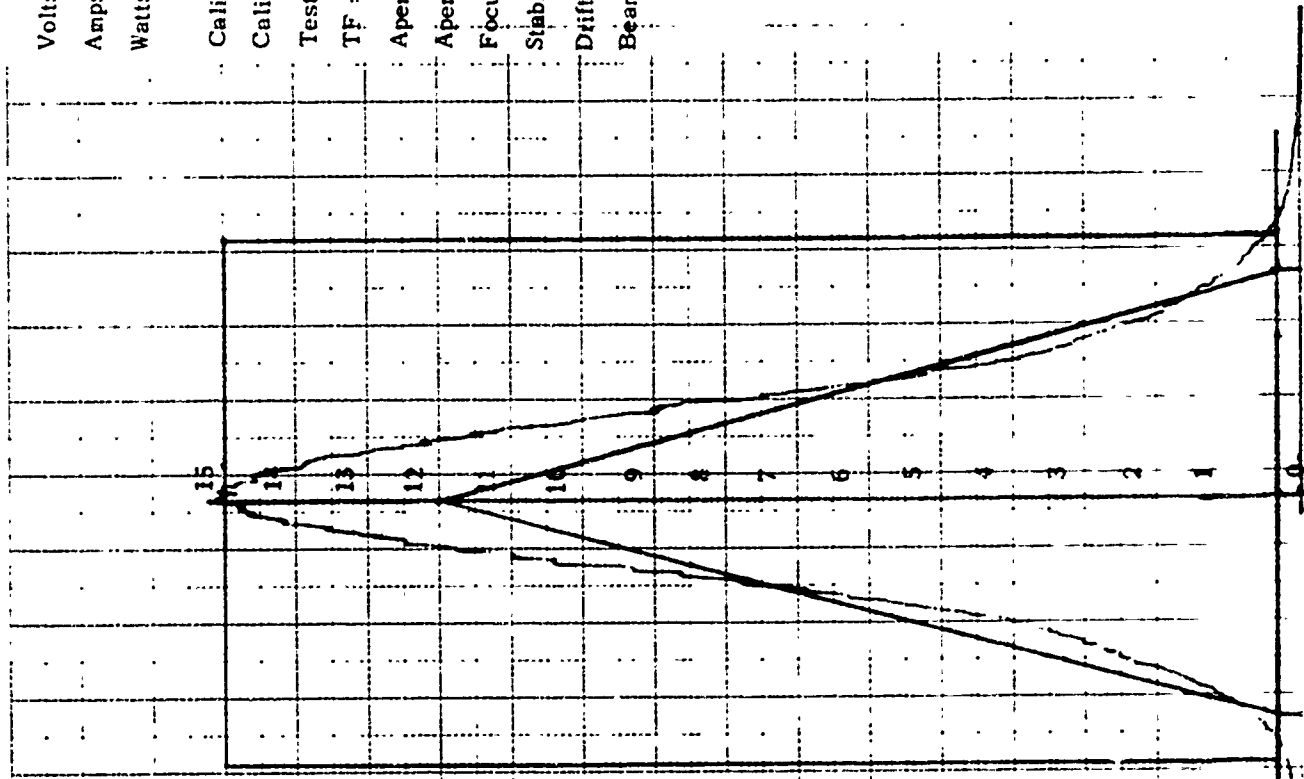
PBC = 5, 910 x CC x SF x TL =      K  
 PBC = 59, 130 x CC x SF x TL =      K

Age      Total     

NVL #1  
 A2 L  
 ± 0° 0' spread.

TEST POINT - JRC  
 DATE 24 FEB 1977  
 BEAM CONFIGURATION: GP EAD  
 SCAN THRU  
 PBC       
 FIGURE 5

Volts      Date: 2.14.77  
 Amps      By: NIC  
 Watts       
 TOTAL FLUX (TF)       
 Calib. Range 2 (C)       
 Calib. Corr. (CC)       
 Test Lamp (TL)      mv  
 TF =  $\frac{2590}{C} \times CC \times TL$       1  
 Aperture (TL)      mv  
 Aperture      1  
 Focus      inches  
 Stability (RMS)      %  
 Drift      %  
 Beam Angle      °



LMP-104

NOT TO BE REPRODUCED

461510

# PHOTOMETRIC TEST FORM

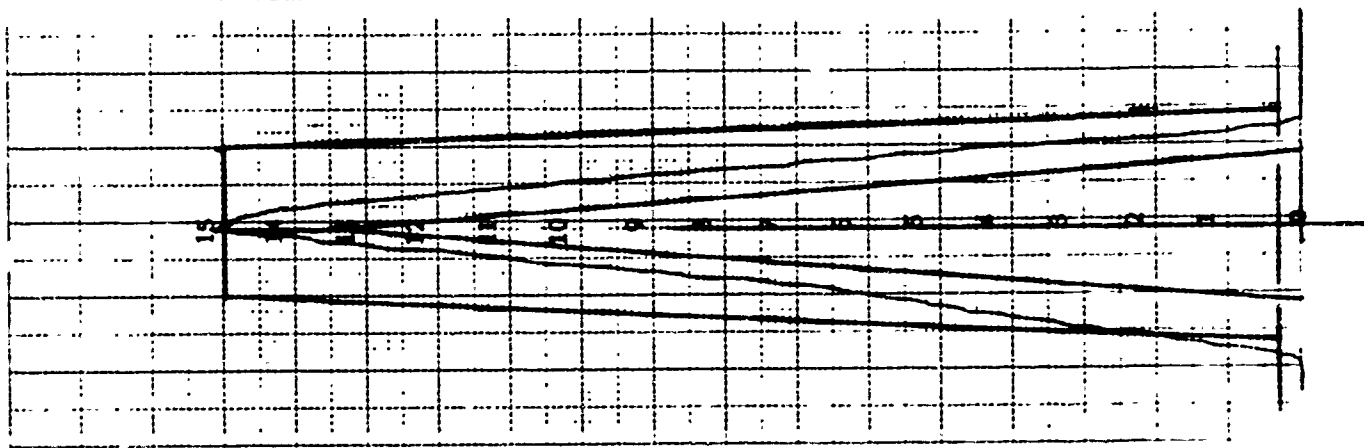
Lamp Type Silver  
 Ceramic # Alum  
 Serial No. A 7E 125

Peak Beam Candlepower (PBC)  
 Calib. 63.0/60.6 on scale  
 Calib. Corr. (CC)  
 Scale Factor (SF) 15.9  
 Test Lamp (TL)  
 PBC = 5, 910 x CC x SF x TL K  
 PBC = 59, 130 x CC x SF x TL K

Age            Total           

NVL #1  
POL L  
± 0° 0' spread

TEST DOT-JHOCK  
 DATE 11-1-68  
 BEAM CONFIGURATION: PREAD  
 SCAN: POLAR  
 P.B.C.             
 FIGURE 17



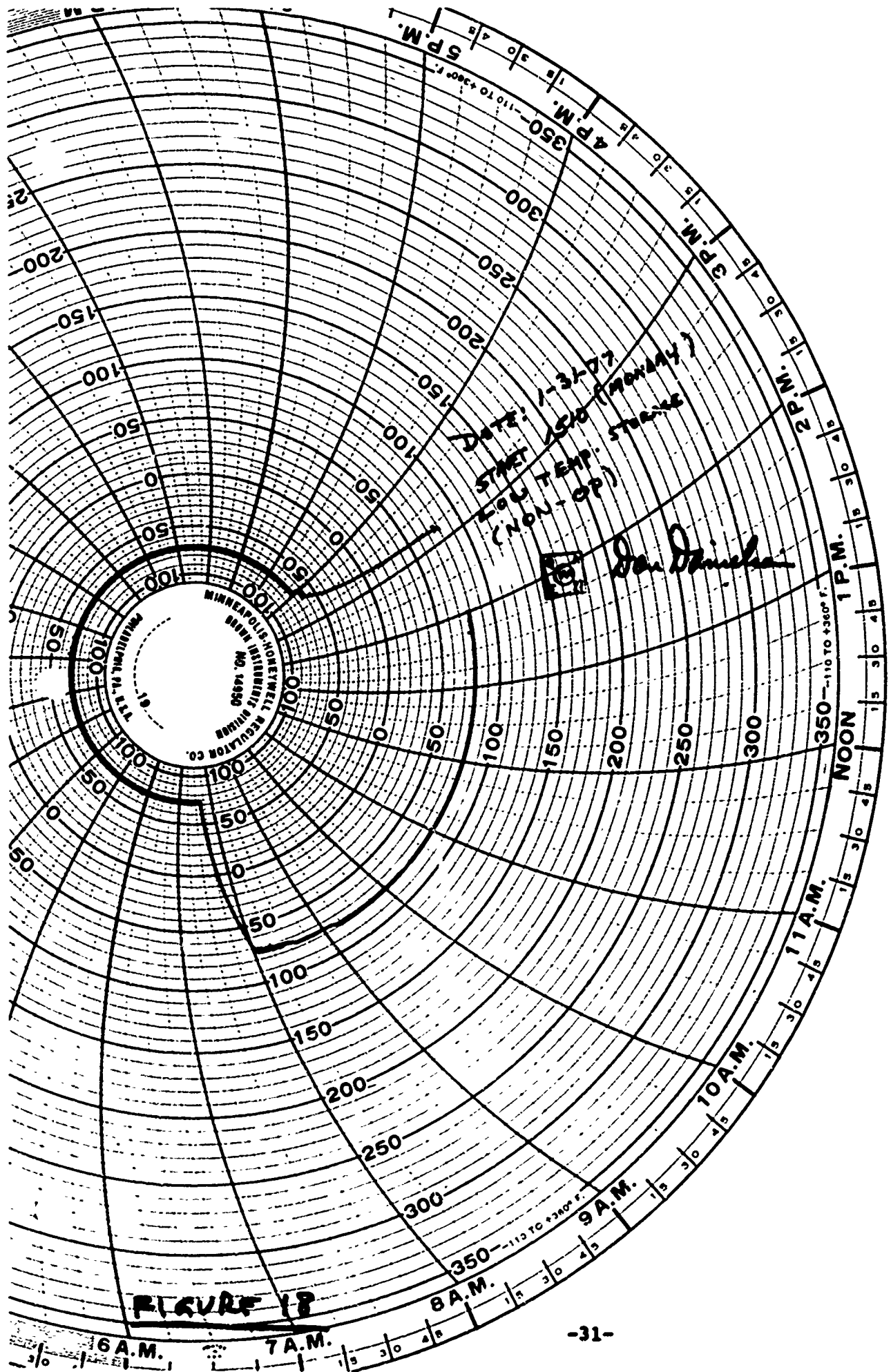
Volts 214.77  
 Date:             
 Amps NVL  
 By:             
 Watts           

TOTAL FLUX (TF)  
 Calib. Range 2 (C)             
 Calib. Cbrr. (CC)             
 Test Lamp (TL)            mv  
 TF =  $\frac{2500}{C} \times CC \times TL$             l  
 Aperture (TL)            mv  
 Aperture            l  
 Focus            inches  
 Stability (RMS)            %  
 Drift            %  
 Beam Angle

### 6.3 Low Temperature Storage

The entire searchlight set was placed in a  $-70^{\circ}\text{F}$  ( $-57^{\circ}\text{C}$ ) cold chamber for a minimum of 12 hours. The chamber temperature was then raised to  $+77^{\circ}\text{F}$  ( $+25^{\circ}\text{C}$ ) for six hours. See the temperature data recorded (Figure 18).

The searchlight's input current exceeded 60 amps for the first two minutes of operation at 28VDC (as was noted in Figure 2). All systems functioned properly at 28 and 24 VDC except for the initial opening of the I.R. filter at 24 VDC. The searchlight was examined and the I.R. filter activating solenoid was found to have had an incorrect spring adjustment. This was corrected. The filter then activated as low as 20 VDC.



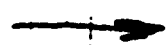
#### 6.4 High Temperature Storage

The entire searchlight set was placed in a +160°F (+71°C), 90/98% relative humidity environment for a minimum of 12 hours. The chamber was then lowered to +77°F (+25°C) for six hours. See the sample temperature data recorded (Figure 19).

Other than the initial starting input current for 28VDC operation, the searchlight functioned properly in all modes at both 24 and 28VDC. Actually, the searchlight did not start on the first attempt at 28VDC. A connecting cable was found loose. It was tightened and the searchlight started on the next attempt.

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TIME: 0730 2/2/77



HUMIDITY OFF  
RETURN TO  
AMB.

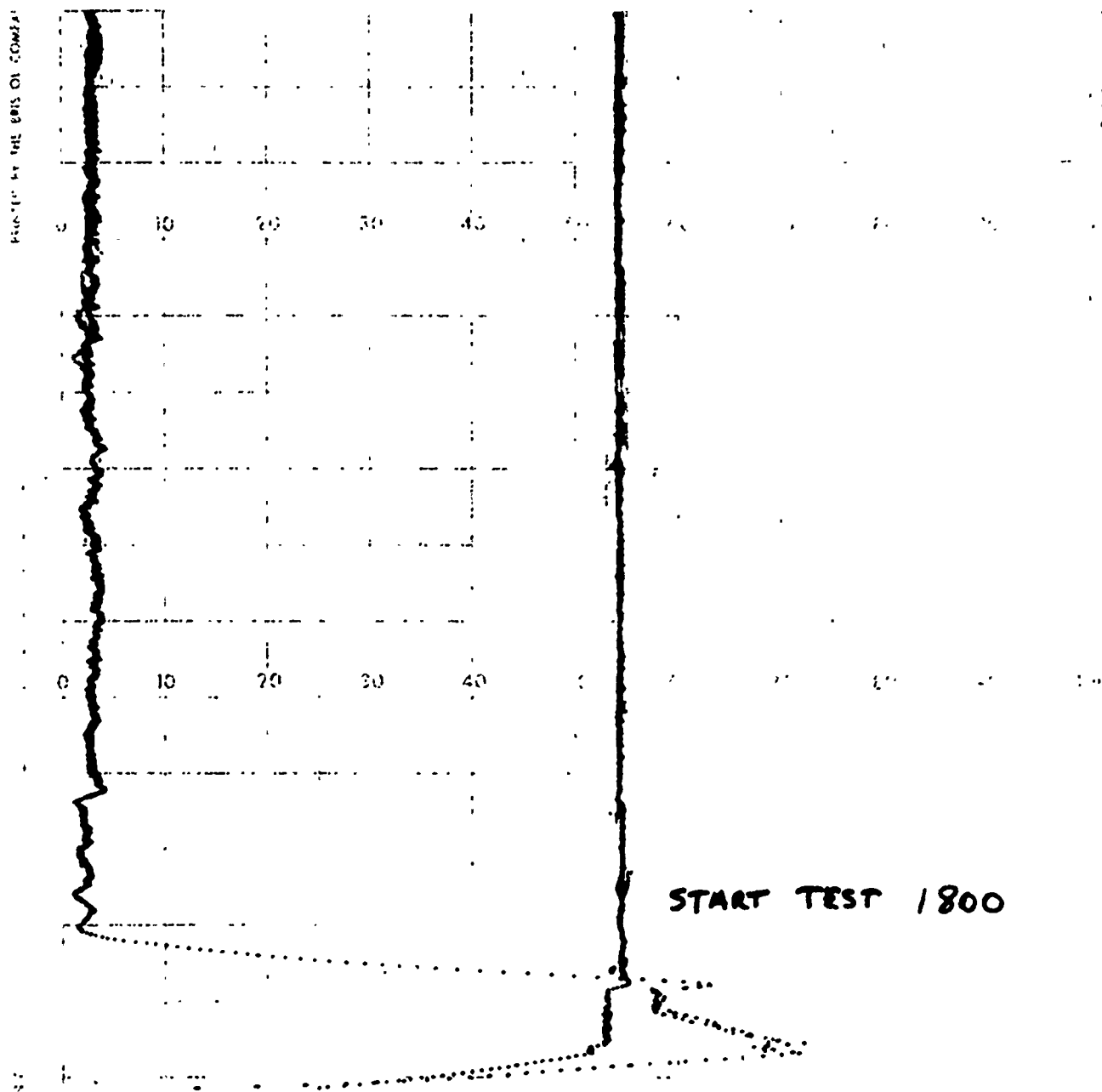
SAMPLE DATA  
HIGH TEMPERATURE STORAGE

FIGURE 19

### 6.5 High Temperature Operation

The searchlight set, less the remote control box, was placed in a +130°F (+54°C) chamber for 8 hours. The relative humidity was maintained at 90/98%. The searchlight was operated at 28 and 24VDC with no malfunctions occurring.

A sample temperature record is shown in Figure 20.



4.5.6.7

HIGH TEMP. OPERATING 2/2/77

(RE: DAAK70-76-C-0270, 4.9)

+ 54°C @ 90-98% R.H.

SAMPLE DATA  
HIGH TEMPERATURE OPERATION  
FIGURE 20

## 6.6 Low Temperature Operation

The searchlight set, less the remote control box, was placed in a  $-40^{\circ}\text{F}$  ( $-40^{\circ}\text{C}$ ) for 8 hours. The searchlight was operated at 28 and 24 VDC with one malfunction occurring. A sample temperature record is shown in Figure 21.

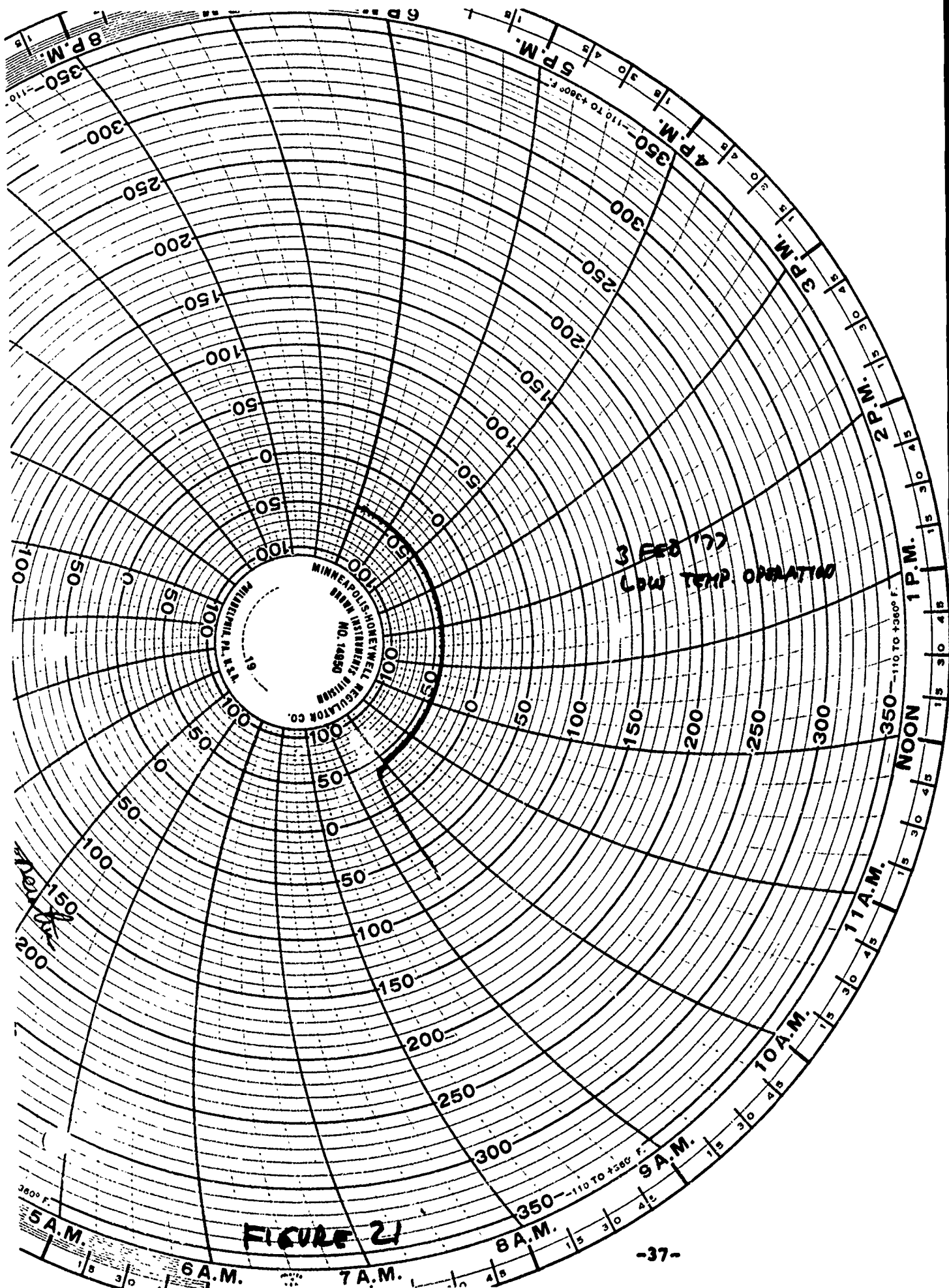
The blackout filter failed to open immediately when initiated at 28VDC,  $-40^{\circ}\text{F}$ , and with the arc lamp turned ON. The filter opened slowly after approximately 0.5 minutes of heating with the arc lamp ON.

The solenoid used for opening the blackout filter is a LEDEX model 183839-001.

LEDEX furnishes the solenoid with one of two standard lubricants. LEDEX Lube 1 has a temperature range of  $-54^{\circ}\text{C}$  to  $+121^{\circ}\text{C}$ . LEDEX Lube 2 has a temperature range of  $-29^{\circ}\text{C}$  to  $+121^{\circ}\text{C}$ . It was believed that Lube 2 was used in the blackout solenoid.

A model 183839-001 solenoid was placed separately in a cold chamber. The temperature was slowly lowered and the solenoid was intermittently activated with 28 VDC at  $5^{\circ}\text{C}$  increments. The solenoid was found free to move until it reached  $-20^{\circ}\text{C}$ . At this temperature the solenoid activated slowly, indicating that the lubricant was hardening. This correlates well with LEDEX's stated lower limit of  $-29^{\circ}\text{C}$  for Lube 2.

It is recommended that all solenoids be lubricated with Lube 1 prior to any future low temperature testing of the searchlight.



## 6.7 Vibration

The searchlight's Optical Unit was subjected to one hour of  $\pm 2.5g$ , 0.5 inch (maximum) double amplitude vibration for one hour (minimum) between 5 and 500 Hz. It was vibrated in each of three axes.

The vibration tests were passed with a minimal amount of loosening of nuts and screws. All screws would normally be installed in manufacture with a chemical or mechanical anti-loosening means. This searchlight did not have said means included, however, as a post vibration test disassembly, inspection and reassembly was planned. For this reason, some screws worked loose. For example, the 2-56 screws retaining the 6<sup>0</sup> spread lens worked loose, causing the small lens to rotate off axis. This was accompanied by a small amount of chipping on the periphery of the lens.

All systems in the searchlight functioned properly at both 28 and 24 VDC following the vibration test.

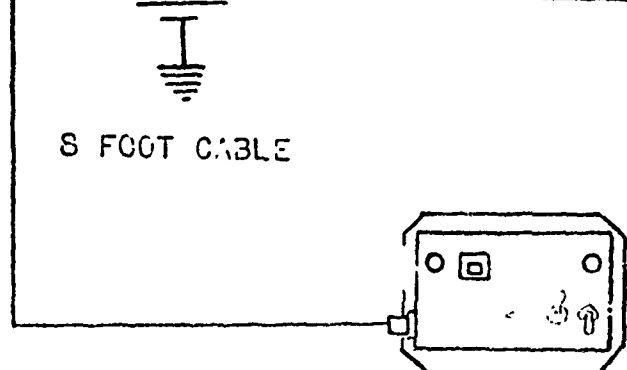
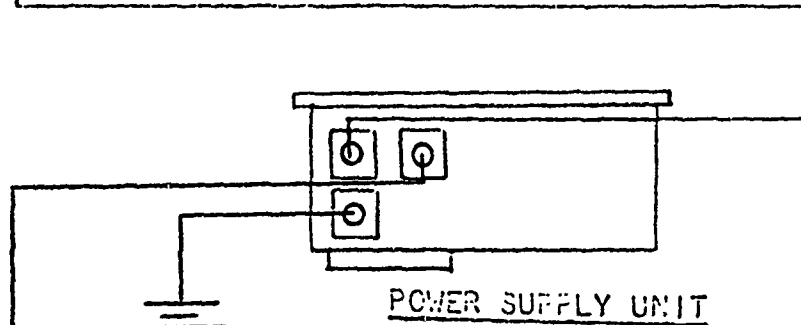
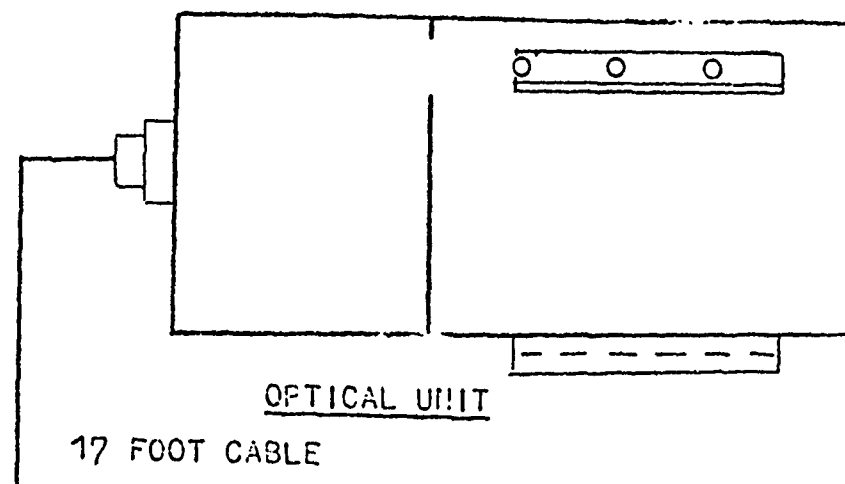
The beam projected from the searchlight was found to be below specification following the vibration tests. This was later traced to the X6257 arc lamp. This cause was darkening of the arc lamp's reflector and is discussed in Section 6.2.

It is concluded that the searchlight is capable of surviving the vibration inputs as specified.

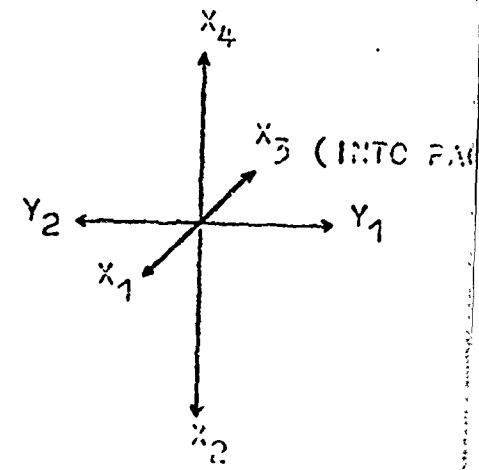
The coordinate axes for the searchlight are shown in Figure 22. Recorded vibration data are shown in Figures 23 through 30.

Figure 23 shows data recorded by the monitor accelerometer when placed adjacent to the control accelerometer during one run in the  $X_1$ - $X_3$  axis. This curve shows the shaker capable of controlling the vibrating package.

DIRECTION	UNIT		
	OPTICAL	POWER SUPPLY	CONTROL BOX
VERTICAL	X2-X4	X2-X4	X2-X4
LATERAL	X1-X3	X1-X3	X1-X3
LONGITUDINAL	Y1-Y2	Y1-Y2	Y1-Y2



REMOTE CONTROL BOX UNIT



SEARCHLIGHT SET  
(COORDINATE AXES)

FIGURE 22  
-39-

## 6.7 Vibration/Continued

Figure 24 shows that there were three resonances in the Optical Unit when vibrating in the  $X_1$ - $X_3$  axis. These occurred at 59, 102 and 136 Hz. The package was vibrated for five minutes at each of these resonance points following the one hour sweeps.

Figure 25 shows the acceleration levels recorded on the end of the Optical Unit adjacent to the electrical connector. The 59 Hz resonance shown coincides with that in Figure 24.

The Optical Unit was mounted for vibration in the  $Y_1$ - $Y_2$ , or longitudinal axis. Again the monitoring accelerometer shows that the shaker could control the package (see Figure 26).

A resonance was noted at 46 Hz in the longitudinal axis (see Figure 27), so a five minute resonance test was conducted at this frequency following the one hour sweep test.

The last one hour sweep test was conducted in the  $X_2$ - $X_4$  axis. Figure 28 shows that the package input was controlled. Monitoring accelerometers detected resonances at 16, 102 and 248 Hz in the center of the Optical Unit (see Figure 29) and at 180 Hz on the end of the unit (see Figure 30). Five (5) minute resonance holds were conducted at these frequencies.



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# SEARCHLIGHT RESONANCE SURVEY

2-4-77

$X_1 - X_3$  AXIS

RUN #1 - MONITOR ADJACENT TO CONTROL

-41-

30

25

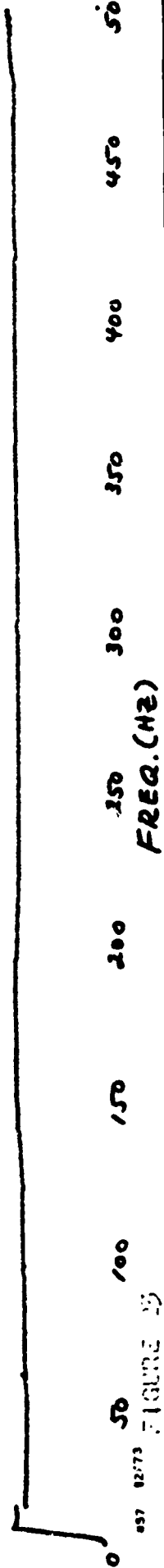
20

15

10

5

G-OUTPUT MONITOR





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# SEARCHLIGHT RESONANCE SURVEY

2-4-77

X<sub>1</sub>-X<sub>3</sub> AXIS

MONITOR ACC. #2

CENTER OF OPTICAL UNIT

-42-

G-OUTPUT MONITOR

59 HZ  
102 HZ  
135 HZ

FREQ. (HZ)

50 100 150 200 250 300 350 400 450 500

957 12/73

FIGURE 24

35

30

25

20

15

10

5

0



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# SEARCHLIGHT RESONANCE SURVEY

2-4-77

X<sub>1</sub> - X<sub>3</sub> Axis

MONITOR ACC. # 3

LAMP HOUSING ADJACENT CONNECTOR

35  
30  
25  
20  
15  
10  
5  
0

G-OUTPUT MONITOR

59.12

0 50 100 150 200 250 300 350 400 450 500

FIGURE 105

FREQ. (Hz)

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# SEARCHLIGHT RESONANCE SURVEY

$Y_1 - Y_2$  AXIS

Run #1

MONITOR ACC.

ADJACENT TO CONTROL



35

30

25

20

15

10

5

G-OUTPUT MONITOR

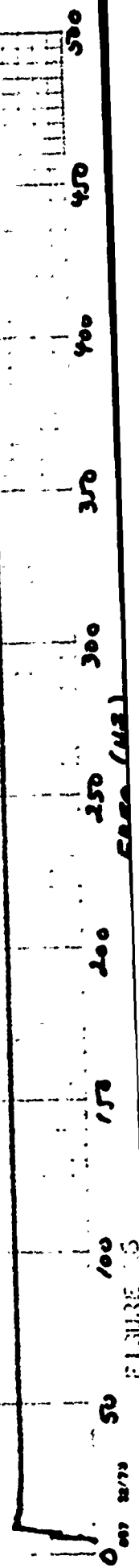


FIGURE 15



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# SEARCHLIGHT RESONANCE SURVEY

2-4-77

$Y_1 - Y_2$  AXIS

RUN # 2

MONITOR REC.

LAMP HOUSING END

ADJACENT TO CONNECTOR

-45-

G-OUTPUT MONITOR

45 Hz

FIGURE 2

FACTOR (Hz)

0 50 100 150 200 250 300 350 400 450 500



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# SEARCHLIGHT RESONANCE SEARCH

2-4-77

X<sub>2</sub> - X<sub>4</sub> AXIS

RUN #1  
MONITOR ACC.  
ADJACENT TO CONTROL

-94-

G-OUTPUT MONITOR

35

30

25

20

15

10

5

0

50

100

150

200

250

300

350

400

450

FREQ (Hz)



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# SEARCHLIGHT RESONANCE SURVEY

2-4-77

X<sub>2</sub>-X<sub>4</sub> AXIS

RUN #2

MONITOR ACC. ON OPTICAL  
HOUSING

-45

G-OUTPUT MONITOR

10 HZ

100 HZ

1000 HZ

0

50

100

150

200

250

300

350

400

450

500

FREQ. (MC)



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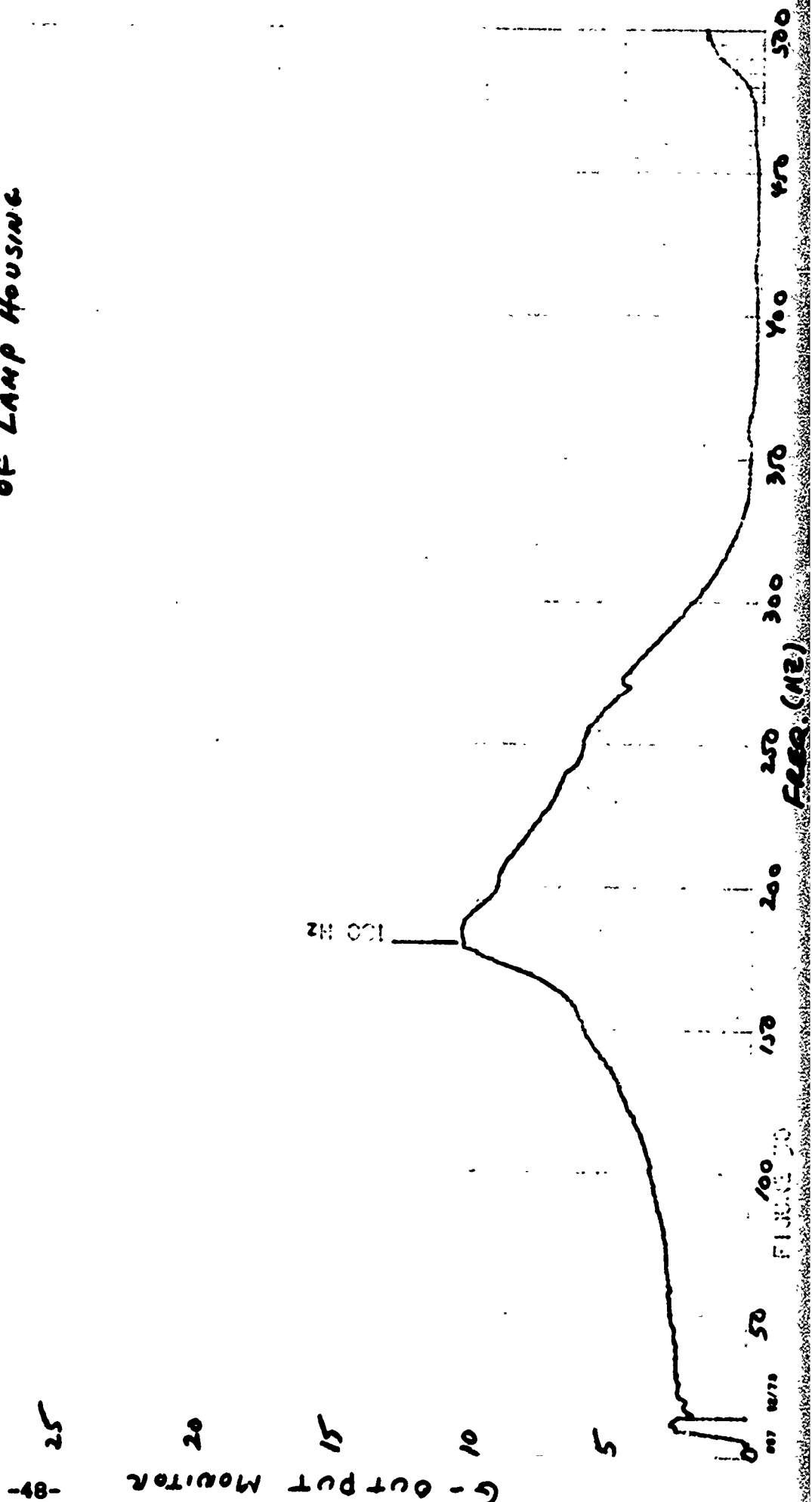
PALO ALTO TUBE DIVISION

2-4-77

# SEARCHLIGHT RESONANCE SURVEY

## X<sub>2</sub>-X<sub>4</sub> AXIS

RUN # 3  
MONITOR ACC. ON END  
OF LAMP HOUSING



## 6.8 Shock

Shock tests were conducted with one high level (450g, 1.0 msec.) and one low level (40g, 18 msec.) half sine shock applied in each direction along each of the three major as noted in Figure 22. These shocks were applied to the searchlight's Optical Unit only.

Table III is a summary of the shock tests. Actual test data and photography of the shock pulses are shown in the Environmental Test Laboratory report, Appendix II. As noted under Remarks in Table III, the arc lamp became intermittantly operational during the shock tests. Other than the temporary short of the inverter (shock drop number 2), the searchlight survived the shock tests.

There is some question of the validity of the shock tests conducted during this Quality Assurance evaluation.

Figure 31 is a photograph of the installation of the armored housing on an M60A1 tank. The Optical Unit is retained within the steel tube marked "TWO MAN LIFT". The armored housing is supported in a cantilevered fashion by a "three-ball support" on the tank's gun mantlet. The original test plan specified that all vibration and shock testing would be conducted with the optical unit in the armor tube and the input levels would be monitored at one of the three-ball supports. The testing facilities chosen, however, could not meet the g levels required with the large load (185 pounds). It was therefore decided that the Optical Unit only would be vibrated and shocked.

It is immediately obvious to the reader that any g level input to the three-ball mount will translate to some different g level and time function at the center of gravity (c.g.) of the armored housing (and Optical Unit). The vibration and shock pulses inputs during this Quality Assurance test are therefore not realistic and did not excite the Optical Unit it will in actual operation.

#### 6.8 Shock/Continued

An earlier version of this searchlight, the AN/VES-4 (XE-3), was exposed to actual gun firing tests at Fort Knox, Kentucky. The searchlight did not fail to function during, or following, any of the firings. The arc lamps did fail, but because of an internal problem not related to the gun firings.

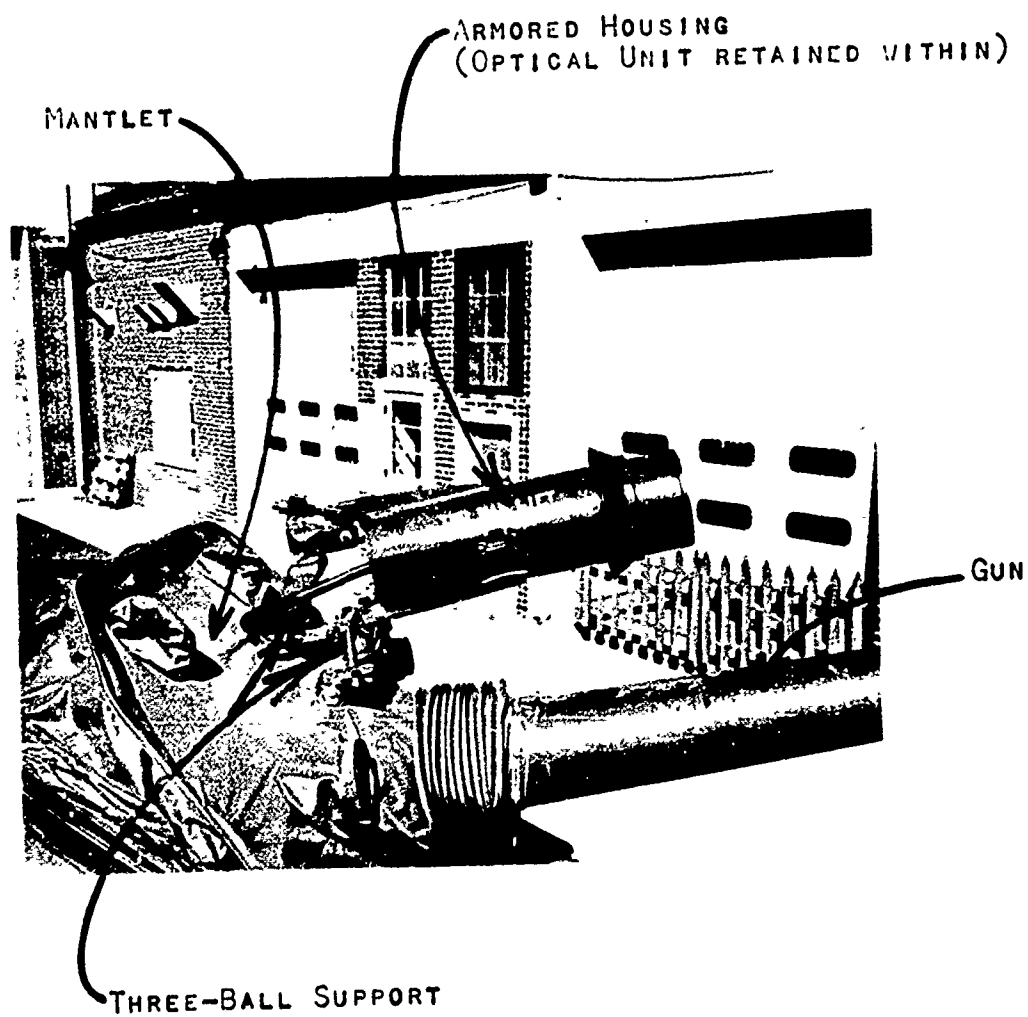
TABLE III  
SHOCK TESTS - OPTICAL UNIT

Drop No.	Direction Of Shock (See Fig. 22)	Recorded "g"	$\frac{1}{2}$ Sine Duration (Msec)	Arc Lamp S/N	All Systems Operational Following Shock	Remarks
1	X4	460	1	A7E172	Yes	Lamp extinguished, stinger stuck to cathode following attempt to relight. Removed lamp A7E172 and put in A7E175.
2	X4	465	1	A7E175	Yes	Lamp blinked but stayed ON. Fan quit. Opened searchlight and found fan DC/AC inverter moved slightly, shorted to chassis. Replaced with new inverter, System now ok.
3	X4	40	18	A7E175	Yes	Again the extinguished and the stinger stuck to the cathode during relight attempt (The second lamp to do so). Both lamps returned to EIMAC. Stingers were freed by putting AC signal into starter solenoid. Put lamp A7E172 back into searchlight.
4	X4	40	18	A7E172	Yes	Lamp extinguished, but relit with manual start. Lamp not damaged.
5	X2	38	18	A73172	Yes	Lamp extinguished, but relit with manual start. Turned off intentionally, then waited two minutes before relighting. Stinger contacted cathode, then hung up. All previous information indicates that the arc lamp's stinger is a problem area. The searchlight itself can withstand shock environments.

TABLE III  
SHOCK TESTS - OPTICAL UNIT

Drop No.	Direction Of Shock (See Fig. 22)	Recorded "g"	$\frac{1}{2}$ Sine Duration (Msec)	Arc Lamp S/N	All Systems Operational Following Shock	Remarks
6	X3	38	18	A7E172	Yes	Lamp still hung up, so not tested with lamp operationally.
7	X1	38	18	A7E172	Yes	See above note.
8	Y2	40	18	A73172	Yes	See above note.
9	Y1	40	?	A7E172	Yes	See above note.
10	Y1	380	1	A7E172	Yes	The arc lamp ignited following this shock. The connector end of the Optical Unit was deformed during this shock input. All systems remained functional, however.
11	Y2	340	1	A7E172	Yes	The arc lamp ignited immediately following this shock.
12	X2	465	1	A7E172	Yes	See above note.
13	X1	450	1	A7E172	Yes	Searchlight drew 87 amps stinger/anode short (short area seen during post shock test lamp inspection).
14	X3	450	1	A7E172	Yes	Lamp would not ignite, stinger still stuck.

The searchlight was inspected following shock tests. The arc lamp was found to have 2 fractured anodes, but would ignite. When starting to operate the searchlight for Post Quality Assurance beam tests, the lamp leaked and became non-operational. Lamp A7E175 put into searchlight, lamp ignited and all systems found operational at 28 and 24 VDC.



INSTALLATION OF ARMORED HOUSING ON M60A1 TANK  
FIGURE 31

## 6.9 Electromagnetic Interference (E.M.I.)

EIMAC had made a recommendation in an earlier program (Armored Illuminator, DAAG53-76-C-0005) that it should investigate means for further reducing the electromagnetic interference generated by the AC fan and inverter package.

Line filtering was added to the original fan circuit and selected E.M.I. tests were conducted at 28VDC. The results of these tests are included in Appendix III. With the added filtering, the Armored Illuminator would have passed the original Quality Assurance tests.

The above tests were conducted with 28VDC input to the searchlight. A low voltage phenomena has appeared wherein the xenon searchlight can pass the E.M.I. requirements at 28.0VDC, but sometimes generate noise at slightly reduced voltages. EIMAC has since found practical means for eliminating E.M.I. at reduced voltages, including the entire operational range of typical tank voltages. This solution will be applied to all searchlight and arc lamp combinations delivered to the customer.

## 7.0 CONCLUSIONS

Two AN/VSS-4(XE-4) searchlight sets have been assembled and delivered to the customer.

One searchlight set was subjected to low temperature storage, high temperature storage, high temperature operation, low temperature operation vibration and shock tests with no irreparable damage occurring.

In addition, EIMAC has investigated means for eliminating electromagnetic interference at other than nominal tank operating voltages.

EIMAC believes that the Searchlight Set program was successful and that a basic searchlight can be built in a reproducible manner in production.

## 8.0 RECOMMENDATIONS

EIMAC wishes to make the following recommendations for future searchlight programs.

- 1) Perform extensive bench test evaluations with the optics to determine the exact positions for optimum projected peak beam candlepower.
- 2) Improve the support structure of the stinger mechanism inside the searchlight arc lamp.
- 3) Specify a low temperature lubricant for all solenoids.

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**APPENDIX I**  
**QUALITY ASSURANCE TEST PROCEDURE**

1

QUALITY ASSURANCE TEST PROCEDURE

CHANGE \_ \_ \_

SEARCHLIGHT SET AN/VSS-4 (XE-4)

(EIMAC Dwg. )

(Original Submitted November 1976)

For

NIGHT VISION LABORATORY

U.S. Army Electronics Command  
Fort Belvoir, Virginia 22060

Contract No. DAAK70-76-C-0270

Purchase Order: 37309

EIMAC, Division of Varian  
301 Industrial Way  
San Carlos, California

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## 1.0 INTRODUCTION

This document establishes the requirements and procedures for Quality Assurance Tests for the Searchlight Set. The purpose of these tests is to demonstrate attainment of design objectives in accordance with Night Vision Laboratory, U.S. Army Electronics Laboratory (NVL), Fort Belvoir, Virginia, Contract Number DAAK70-76-C-0270, dated September 30, 1976 and amended (Modification P00001) November 9, 1976.

## 2.0 APPLICABLE DOCUMENTS

The following documents of the issue indicated form a part of this document to the extent specified herein:

### 2.1 Military Specifications

DAAK-70-76-C-0270 Purchase Description for Searchlight Set AN/VSS-4(XE-4).

### 2.2 Military Standards

MIL-STD-810 Environmental Test Methods for Aerospace and Ground Equipment.

### 2.3 Document Precedence

This is the sole document controlling Quality Assurance Test operations. If there are any discrepancies between this document and applicable documents, the provisions of MIL-STD-810 will prevail.

### 3.0 REQUIREMENTS

#### 3.1 Witnessing of Tests

All tests performed per this document may be witnessed by an EIMAC Quality Control representative.

#### 3.2 Standard Conditions

All tests, except those utilizing special environments or as otherwise specified will be conducted under the following standard ambient conditions:

- (a) Temperature:  $77^{\circ} \pm 22^{\circ}\text{F}$
- (b) Relative Humidity: 99% or less
- (c) Barometric Pressure: Local atmospheric

#### 3.3 Instrument Calibration

All inspection, measuring and test equipment used for taking data will be calibrated and the due date for recalibration will be displayed on each item. Those items of test equipment requiring calibration before use will be calibrated immediately prior to use on any specific test.

#### 3.4 Tolerances

All measurements of test conditions will be made with the equipment called out for each individual test or an equivalent. All equipment will be listed on the Test Equipment List (See Appendix I for sample log sheet). The test tolerances and performance parameters will be as called out in each individual test section in Paragraph 4.5.

#### 3.5 Failures

In the event an out-of-tolerance reading or failure is obtained during any test sequence, the test will

### 3.5- Continued

proceed to the first safe shutdown point and terminate. At this point, operation of all test equipment and the test setup will be checked. If the out-of-tolerance reading or failure is due to test equipment or test setup malfunction, the equipment or setup will be replaced or repaired. Any repair affecting calibration of data gathering equipment will be followed by recalibration. After repair or replacement of test equipment, testing will be resumed at a point determined by the test conductor which will confirm correct operation at the point in the test where the out-of-tolerance reading or failure was observed. All action will be recorded in the Daily Log Sheet (see Appendix I for sample sheet).

If the out-of-tolerance reading or failure is determined to have occurred on the test item, testing will be suspended, and the customer will be notified within twenty-four (24) hours. Any resumption or re-test will be as mutually agreed to between EIMAC and Night Vision Laboratory.

### 3.6 Test Location

Unless otherwise specified, all tests will be performed at EIMAC, San Carlos, California.

## 4.0 TESTS

### 4.1 Test Items

The Searchlight Set comprised of the following items will be subjected to the tests of Paragraph 4.5:

- (a) One (1) 193159, Remote Control Box Unit
- (b) One (1) 193158, Power Supply Unit
- (c) One (1) , Total Optical Unit
- (d) One (1) 194247, Interconnecting Cable (8 ft.)
- (e) One (1) 193995, Interconnecting Cable (17 ft.)

Figure 1 is a photograph of the assembled test items.

### 4.2 Test Sequence

Tests will be performed on each Searchlight Set in the order presented below:

<u>Para.</u>	<u>Test</u>
4.5.1	Starting and Normal Operation
4.5.2	Beam Characteristics
4.5.3	Low Temperature Storage
4.5.4	High Temperature Storage
4.5.5	Low Temperature Operation
4.5.6	High Temperature Operation
4.5.7	Shock*
4.5.8	Vibration*

\*These two tests may be conducted in reverse order.  
Table I shows the test sequence planned.

### 4.3 Test Data

Test data will be recorded on test Data Summary Sheets as presented in Appendix I. (The individual test requirements are presented on Sample Test Data Summary Sheets with each test of Paragraph 4.5). Other data will be graphically recorded wherever practicable as backup and summarized as required on the data sheets. Pertinent information regarding test operations, including

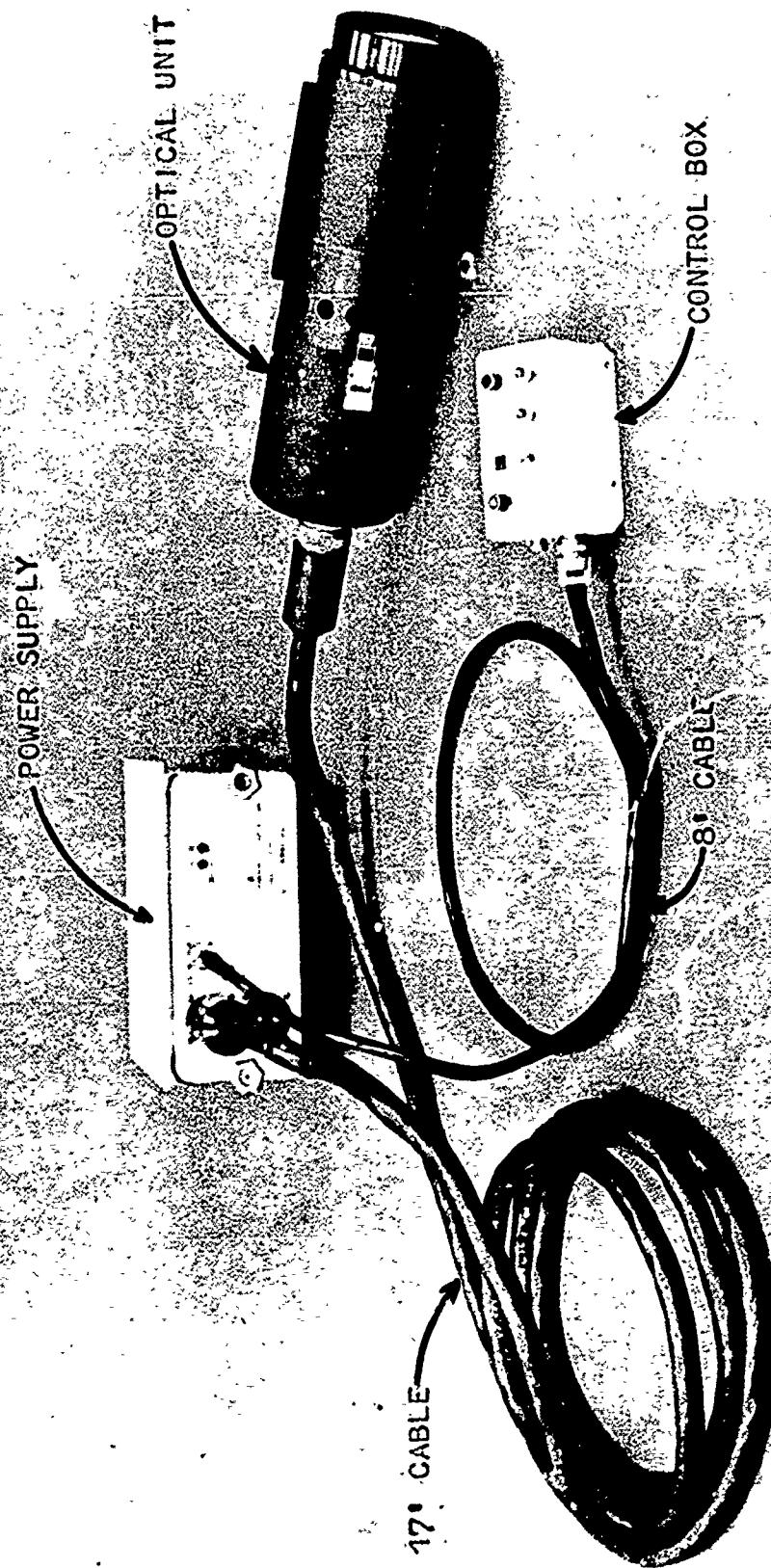


FIGURE 1: EIMAC SEARCHLIGHT SET AN/VSS-4(XE-4)

TABLE I: TEST SEQUENCE FOR QUALITY ASSURANCE TESTING OF THE SEARCHLIGHT SET

EIMAC TEST PROCEDURE PARAGRAPH	TEST	TEST SEQUENCE
4.5.1	Starting & Normal Operation (22.0/28.0 VDC)	1, 4, 6, 8, 10, 12, 15,
4.5.2	Beam Characteristics	2, 13, 16
4.5.3	Low Temperature Storage (0 VDC)	3,
4.5.4	High Temperature Storage (0 VDC)	5,
4.5.5	Low Temperature Operation	7, (in situ)
4.5.6	High Temperature Operation	9, (in situ)
4.5.7*	Shock (Operating, 28.0VDC)	11,
4.5.8*	Vibration (Operating, 28.0VDC)	14,

\* These two tests may be conducted in reverse order.

#### 4.3 Continued

run time on the Searchlight Set will be recorded on the Daily Log Sheet (Appendix I).

#### 4.4 Test Constraints

Each test sequence of paragraph 4.5 will be performed only after successful completion of the previous test as outlined in Paragraph 4.2.

#### 4.5 Test Procedures

Successful completion of all tests in this paragraph will constitute quality assurance of the Searchlight Set AN/VSS-4(XE-4).

4.5.1 TEST STARTING AND NORMAL OPERATION (RE: DAAK70-76-C-0270, 4.4

4.5.1.1 TEST LOCATION EIMAC

4.5.1.2 TEST OBJECTIVE To determine the starting and operating characteristics of the Searchlight Set.

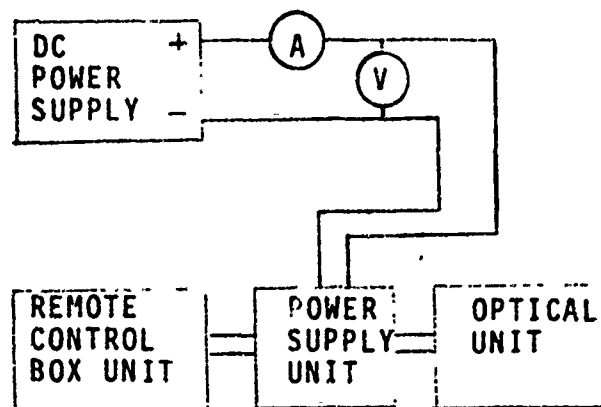
4.5.1.3 REJECTION CRITERIA Failure of the Searchlight Set to ignite, ignition time in excess of three (3) seconds continuous operation input in excess of sixty (60) amperes, or time to change operating modes in excess of two (2) seconds, when supplied with 28 Vdc or 24 Vdc.

4.5.1.4 SPECIAL TEST CONDITIONS None.

4.5.1.5 TEST EQUIPMENT

EQUIPMENT	MINIMUM RANGE	ACCURACY
D.C. Power Supply	24 to 28 Vdc	N/A
Voltmeter	24 to 28 Vdc	$\pm 3\%$
Ammeter	0 to 60 Adc	$\pm 3\%$
Stopwatch	0 to 3 Seconds	$\pm 3\%$

#### 4.5.1.6 TEST SETUP SCHEMATIC



#### 4.5.1.7 DETAIL TEST PROCEDURE

- 4.5.1.7.1 Adjust the D.C. power supply to 28 Vdc and start the searchlight in the Compact, Open and Visible modes. Determine and record the time to ignite and maintain ignition. Record the searchlight current.
- 4.5.1.7.2 After the illuminator is ON, switch from the Open mode to the Blackout mode and then back to the Open mode. Record the time to change light modes.
- 4.5.1.7.3 Return the searchlight to the Open mode, switch from the Compact beam mode to the Spread beam mode and then back to the Compact beam mode. Record the time to change beam modes.
- 4.5.1.7.4 Return the searchlight to the Compact mode, switch from the Visible to the I.R. mode and then back to the Visible mode. Record the time to change beam modes.
- 4.5.1.7.5 Repeat 4.5.1.7.1 through 4.5.1.7.4, but readjust D.C. power to 24 Vdc.
- 4.5.1.7.6 Record all data.

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4.5.2 TEST BEAM CHARACTERISTICS (RE: DAAK70-76-C-0270, 4.5)

4.5.2.1 TEST LOCATION EIMAC

4.5.2.2 TEST OBJECTIVE To determine the intensity vs. angle characteristics of the Searchlight Set in both the compact visible 2 degrees) and spread visible (6 degrees) operating modes.

4.5.2.3 REJECTION CRITERIA Beam Divergence: The beam pattern in the narrow beam shall be square. The azimuthal beam divergence of the illuminator shall be variable from a nominal value of 2.5 degrees in the compact beam mode to 6 degrees in the spread beam mode.

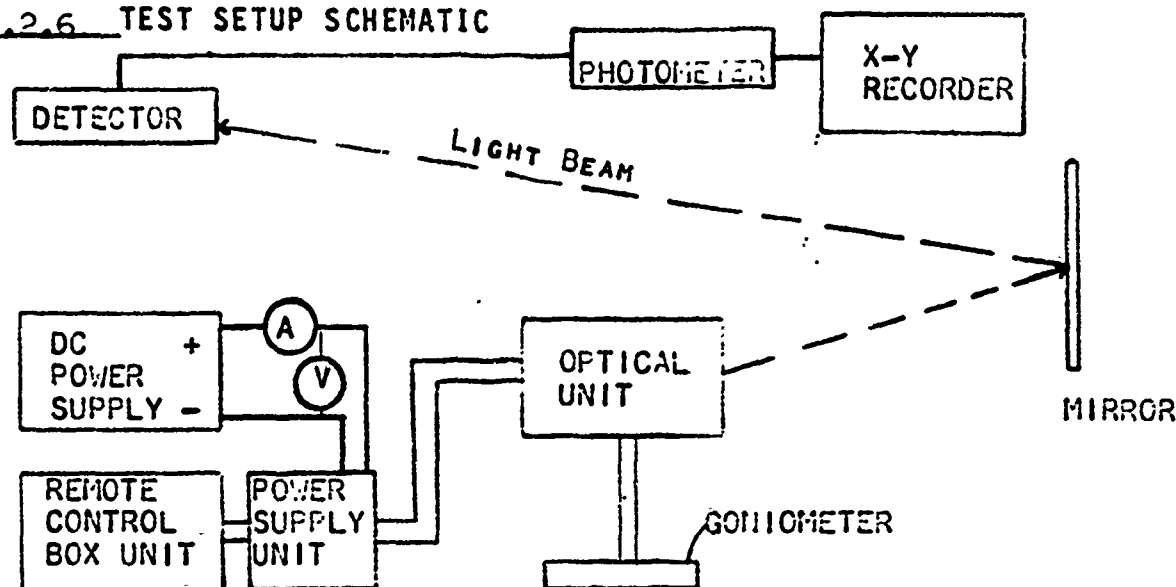
Beam Intensity Distribution: With an input voltage of 28 volt D.C. the illuminator shall provide a peak beam intensity of at least 20 million candelas in the compact beam mode. (See Figures 2 and 3). In the spread beam mode, the azimuthal intensity distribution shall fall within the acceptable region on Figure 4. The beam edge patterns shall comply to the appropriate plot in Figure 5.

4.5.2.4 SPECIAL TEST CONDITIONS: None

4.5.2.5 TEST EQUIPMENT

EQUIPMENT	MINIMUM RANGE	ACCURACY
D.C. Power Supply	28 VDC	N/A
Voltmeter	0 to 28 VDC	$\pm 3\%$
Ammeter	0 to 70 ADC	$\pm 3\%$
Detector/Photometer	$30 \times 10^6$ Candelas	$\pm 5\%$
X-Y Recorder	-----	$\pm 5\%$
Goniometer	Azimuthal: $\pm 4$ Degrees	N/A
	Vertical: $\pm 2$ Degrees	N/A

#### 4.5.2.6 TEST SETUP SCHEMATIC



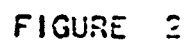
#### 4.5.2.7 DETAIL TEST PROCEDURE

**Note:** Measure the peak beam chandlepower in the following test procedure with a photometer corrected to have a response within plus or minus 5% of the Standard International Commission on Illumination Curve for photopic vision of the human eye. The photometer shall be calibrated monthly to relate meter readings to footcandles by comparison with the illuminance of footcandles of a standard lamp operating at a color temperature of  $2870^{\circ}\text{K} \pm 50^{\circ}\text{K}$ .

- 4.5.2.7.1 Mount the searchlight in a goniometer with the projected beam axis directed towards the mirror.
- 4.5.2.7.2 Operate the searchlight system at 28VDC input for two hours in the Compact, Open and Visible beam modes prior to recording data.
- 4.5.2.7.3 Adjust the searchlight orientation for peak beam intensity by moving the beam vertically and horizontally over the detector.
- 4.5.2.7.4 Rotate the goniometer so that an X-Y plot of the azimuthal scan of the intensity vs. angle is recorded through the peak beam intensity point.
- 4.5.2.7.5 Repeat 4.5.2.7.3 and 4.5.2.7.4 but with the beam lowered (and then raised)  $0.5^{\circ}$ ,  $1.0^{\circ}$  and  $1.25^{\circ}$ .
- 4.5.2.7.6 Change the searchlight to the spread visible mode and repeat 4.5.2.7.5.

- 4.5.2.7.7 Return the searchlight to the narrow beam mode and reorient to the peak beam intensity position.
- 4.5.2.7.8 Rotate the goniometer so that an X-Y plot of the polar scan of the intensity vs. angle is recorded through the peak beam intensity point.
- 4.5.2.7.9 Change the searchlight to the spread visible mode and repeat 4.5.2.7.7.
- 4.5.2.7.10 Calculate the peak intensity in candelas from the foot candle value recorded.
- 4.5.2.7.11 Plot the reduced data on copies of Figure 2 through 5 as applicable.
- 4.5.2.7.12 Record data on Test Data Summary Sheet.

## ELEVATION: \_\_\_\_\_ DEGREES



POLAR COMBACT INTENSITY DISTRIBUTION  
(ACCEPTABLE ZONE IS CROSS-HATCHED AREA)

ELEVATION: \_\_\_\_\_ DEGREES

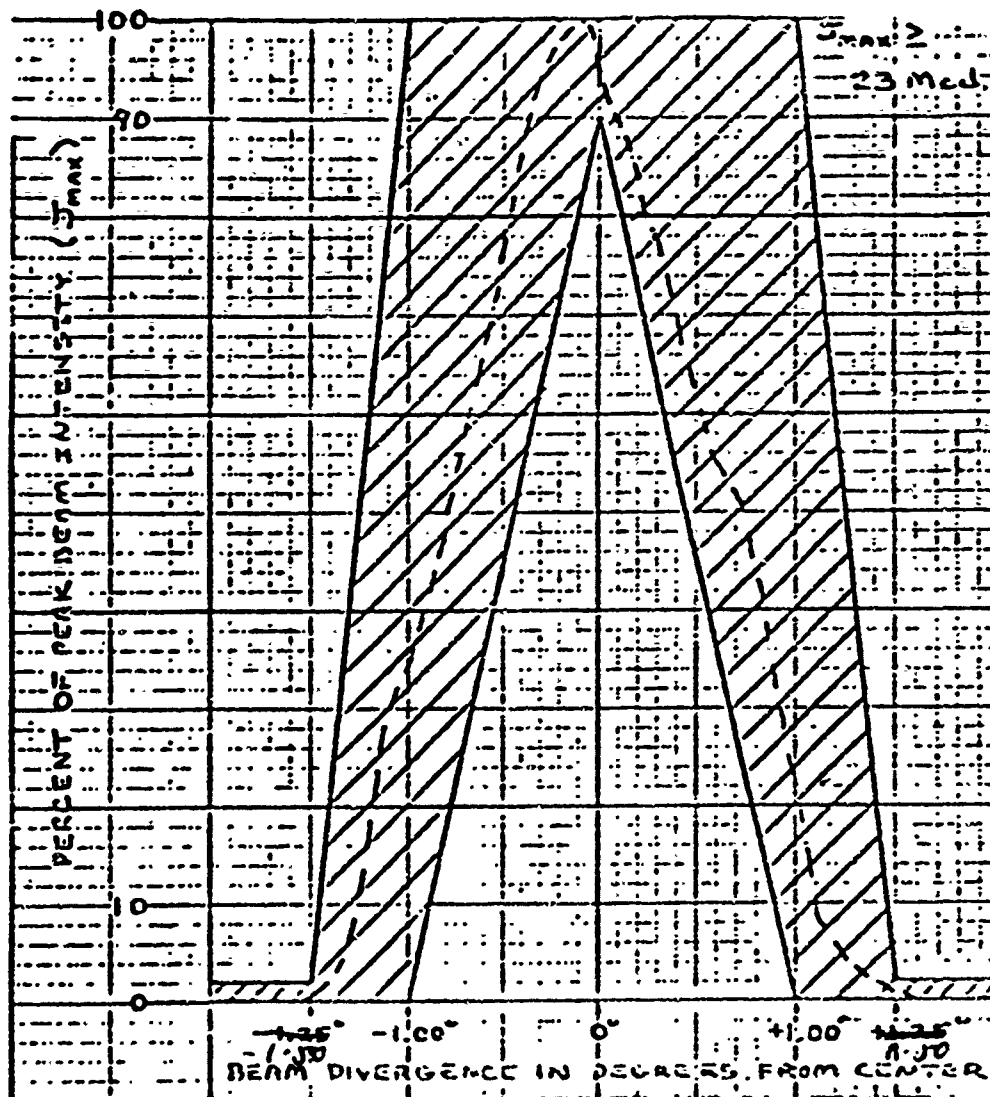


FIGURE 3

AZIMUTHAL SPREAD INTENSITY DISTRIBUTION  
 (ACCEPTABLE ZONE IS CROSS-HATCHED AREA)

ELEVATION: \_\_\_\_\_ DEGREES

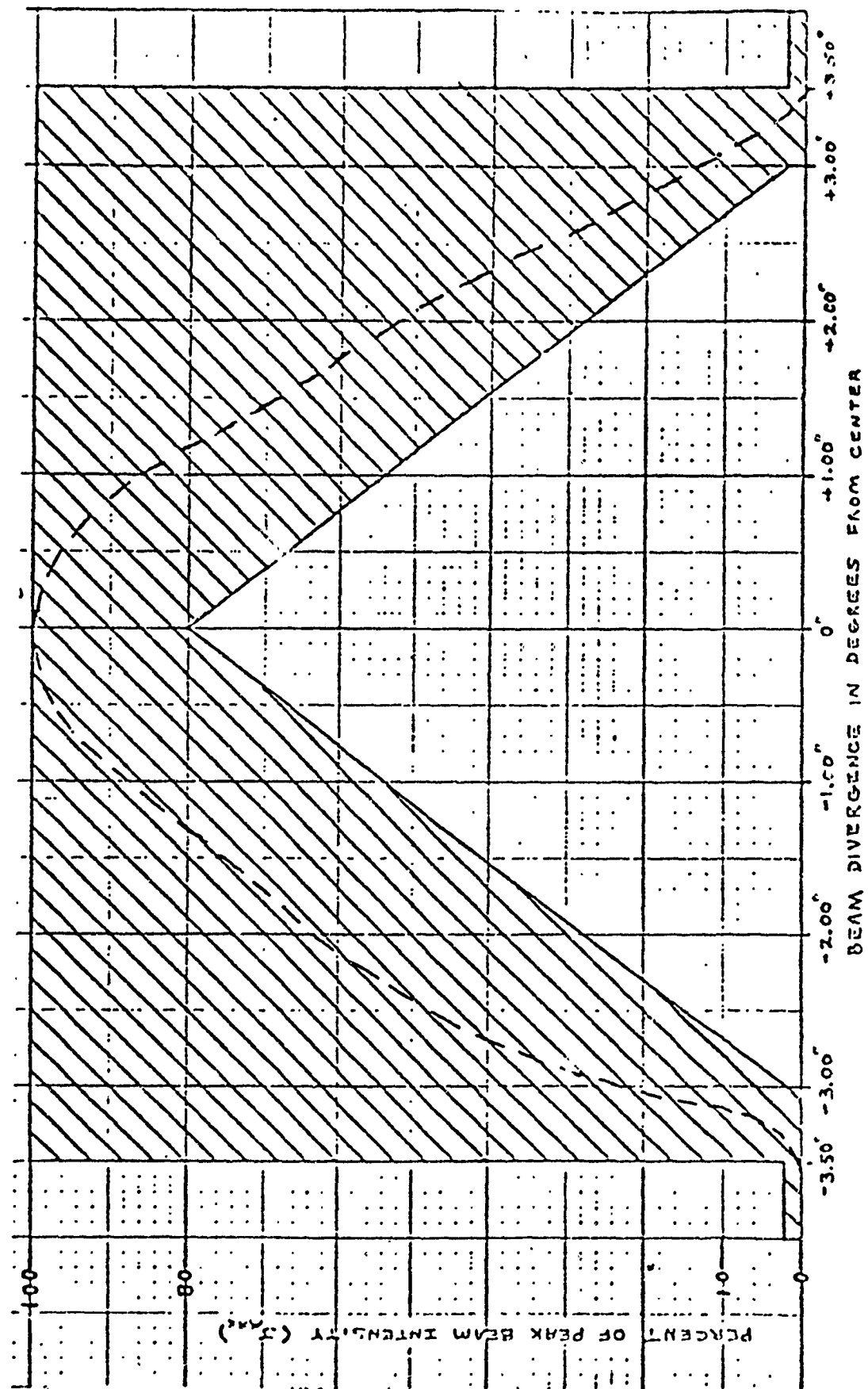
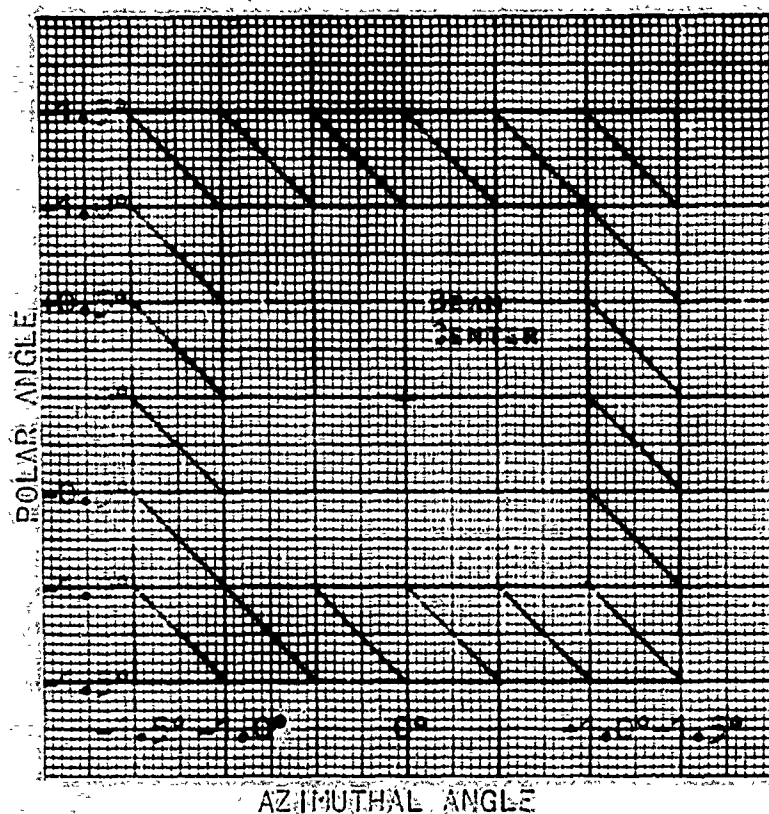


FIGURE 4

TEST: \_\_\_\_\_



ACCEPTABLE ZONES FOR EDGE  
OF BEAM PATTERN FOR CONTACT  
BEAM MODE AND SPREAD BEAM MODE  
(LOCUS OF POINTS AT 2% OF PEAK  
BEAM INTENSITY SHALL FALL WITHIN  
CROSS-HATCHED AREA.)

CONTACT BEAM MODE

SPREAD BEAM MODE

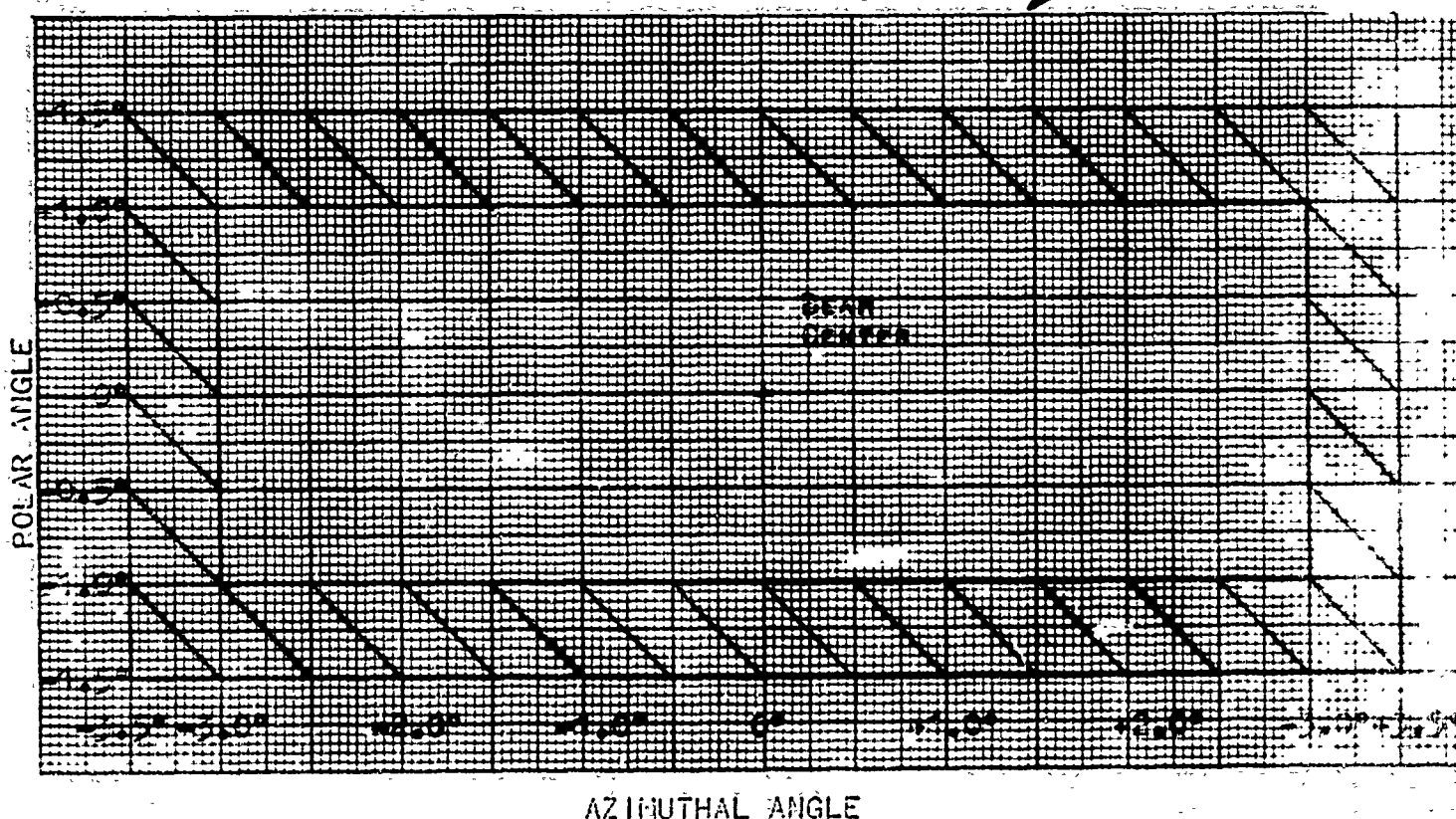


FIGURE 5

TEST TITLE: BEAM CHARACTERISTICS

DATE: 11/76

TEST: PRE QUALITY ASSURANCE

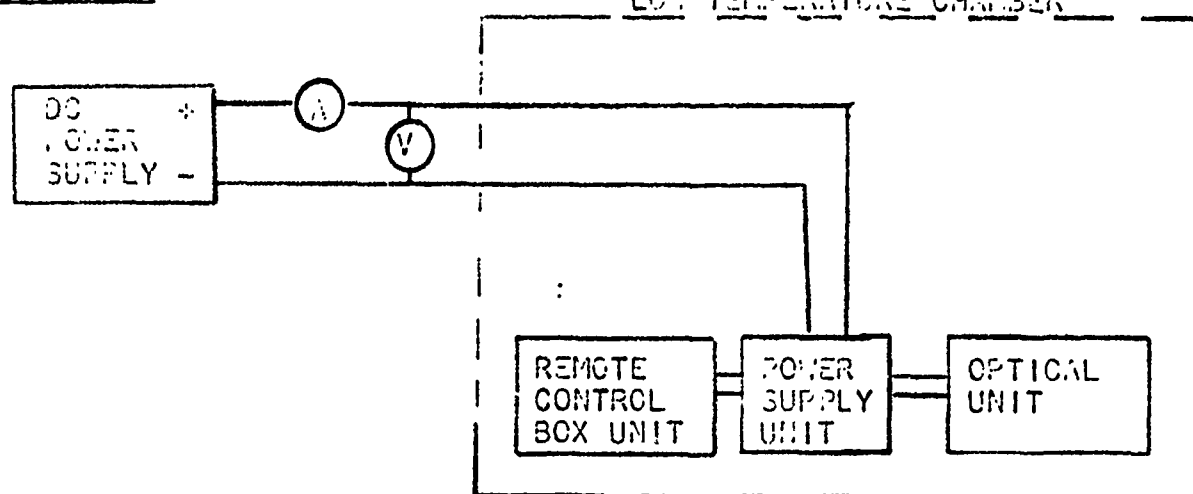
SERIAL NUMBER:

[illegible]

- 4.5.3 TEST LOW TEMPERATURE STORAGE (RE: DAAK70-76-C-0270, 4.6)
- 4.5.3.1 TEST LOCATION Varian Environmental Test Lab.
- 4.5.3.2 TEST OBJECTIVE To determine if the Searchlight Set will start and then operate in all modes following storage at minus 70<sup>0</sup> Fahrenheit (-57<sup>0</sup>C).
- 4.5.3.3 REJECTION CRITERIA Failure to start and then operate per the requirements of 4.5.1, Starting and Normal Operation, or evidence of damage.
- 4.5.3.4 SPECIAL TEST CONDITIONS This test will be run at standard conditions, except that the temperature will be maintained at minus 70<sup>0</sup> Fahrenheit (-57<sup>0</sup>C).
- 4.5.3.5 TEST EQUIPMENT

EQUIPMENT	MINIMUM RANGE	ACCURACY
Low Temperature Chamber with Recorder	75 <sup>0</sup> to -70 <sup>0</sup> F	+3%
D.C. Power Supply	28 VDC, 60A	N/A
Voltmeter	0 to 28 VDC	+3%
Ammeter	0 to 60 ADC	+3%

#### 4.5.3.6 TEST SETUP SCHEMATIC



#### 4.5.3.7 DETAIL TEST PROCEDURE

- 4.5.3.7.1 Place non-operating searchlight into minus 70° Fahrenheit (-57°C) low temperature chamber.
- 4.5.3.7.2 Maintain temperature at minus 70° Fahrenheit for 12 hours.
- 4.5.3.7.3 Raise temperature to room temperature and maintain for six hours.
- 4.5.3.7.4 Test searchlight per the requirements of 4.5.1, Starting and Normal Operation. Inspect for evidence of damage.
- 4.5.3.7.5 Record data.

TEST TITLE: STARTING AND NORMAL OPERATION

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TEST: POST LOW TEMPERATURE STORAGE

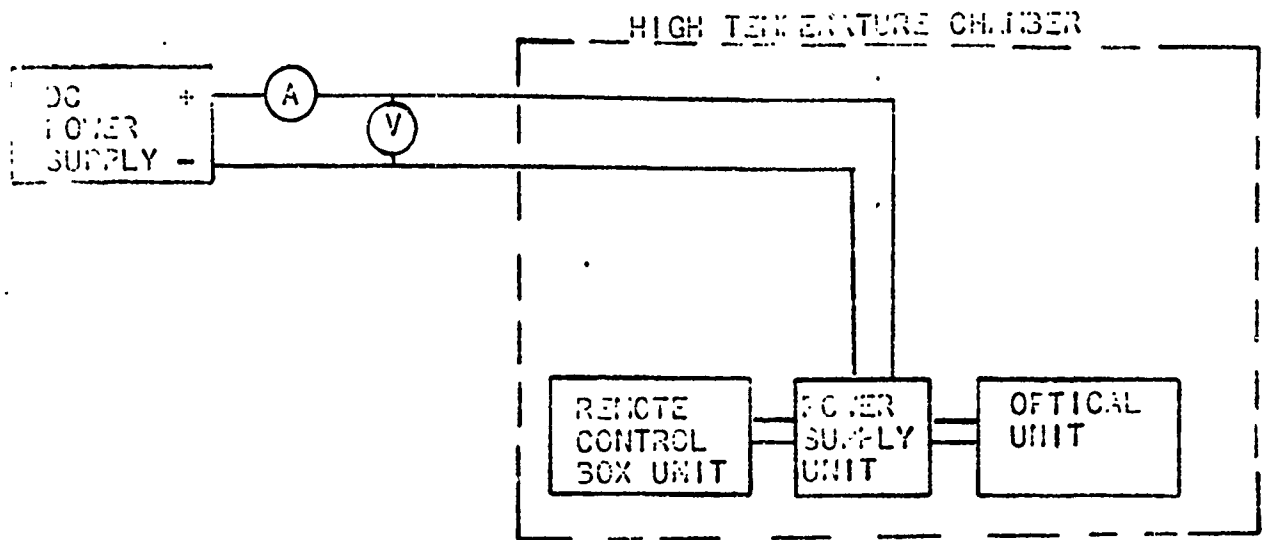
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- 4.5.4 TEST HIGH TEMPERATURE STORAGE (RE: DAAK70-76-C-0270, 4.7)
- 4.5.4.1 TEST LOCATION Varian Environmental Test Lab.
- 4.5.4.2 TEST OBJECTIVE To determine if the Searchlight Set will start and then operate in all modes following storage at plus 160° Fahrenheit (+71°C).
- 4.5.4.3 REJECTION CRITERIA Failure to start and then operate per the requirements of 4.5.1, Starting and Normal Operation or evidence of damage.
- 4.5.4.4 SPECIAL TEST CONDITIONS This test will be run at standard conditions, except that the temperature will be maintained at plus 160° Fahrenheit (+71°C).
- 4.5.4.5 TEST EQUIPMENT

EQUIPMENT	MINIMUM RANGE	ACCURACY
High Temperature Chamber with Recorder	75° to 160°F	+3%
D.C. Power Supply	28 VDC, 60 ADC	N/A
Voltmeter	0 to 28 VDC	+3%
Ammeter	0 to 60 ADC	+3%

#### 4.5.4.6 TEST SETUP SCHEMATIC



#### 4.5.4.7 DETAIL TEST PROCEDURE

- 4.5.4.7.1 Place non-operating searchlight system into plus 160° Fahrenheit (71°C) high temperature chamber.
- 4.5.4.7.2 Maintain temperature at plus 160° Fahrenheit with maximum humidity (90 to 98%) for 12 hours.
- 4.5.4.7.3 Lower temperature to room temperature and maintain for six hours.
- 4.5.4.7.4 Test searchlight per the requirements of 4.5.1, Starting and Normal Operation. Inspect for evidence of damage.
- 4.5.4.7.5 Record data.

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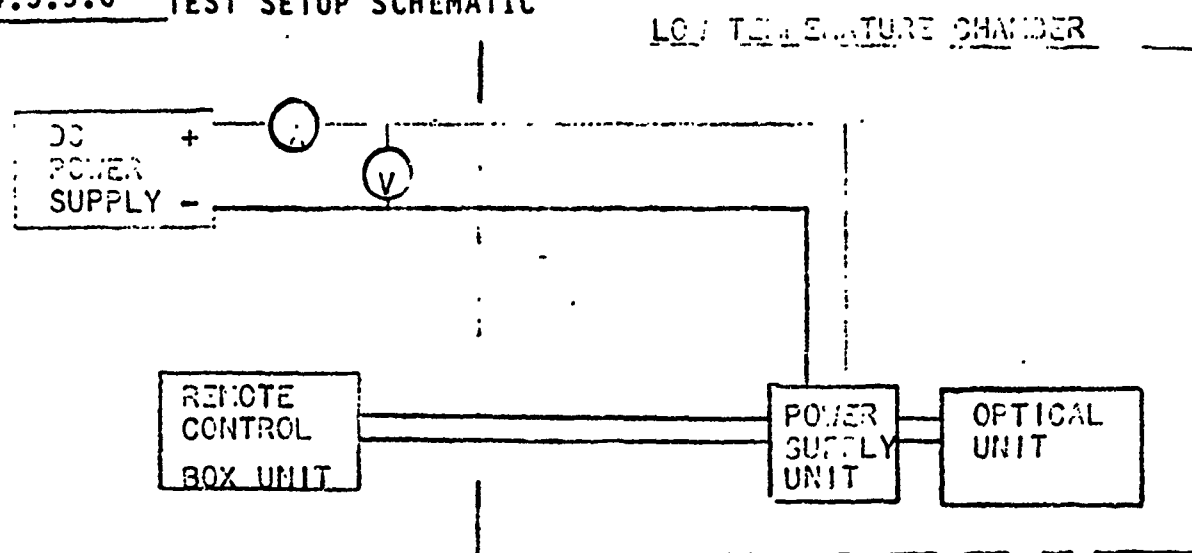
SERIAL NUMBER:

-20-

- 4.5.5 TEST LOW TEMPERATURE OPERATION (RE: DAAK70-76-C0270, 4.8)
- 4.5.5.1 TEST LOCATION Varian Environmental Test Lab.
- 4.5.5.2 TEST OBJECTIVE To determine if the Searchlight Set will start and then operate in all modes when maintained in a minus 25° Fahrenheit (-32°C) atmosphere.
- 4.5.5.3 REJECTION CRITERIA Failure to start and then operate per the requirements of 4.5.1, Starting and Normal Operation, or evidence of damage.
- 4.5.5.4 SPECIAL TEST CONDITIONS This test will be run at standard conditions except that the temperature will be maintained at minus 25° Fahrenheit (-32°C).
- 4.5.5.5 TEST EQUIPMENT

EQUIPMENT	MINIMUM RANGE	ACCURACY
Low Temperature Chamber with Recorder	75°F to -25°F	±3%
D.C. Power Supply	28 VDC, 60 A	N/A
Voltmeter	0 to 28 VDC	±3%
Ammeter	0 to 60 ADC	±3%

#### 4.5.5.6 TEST SETUP SCHEMATIC



#### 4.5.5.7 DETAIL TEST PROCEDURE

- 4.5.5.7.1 Place non-operating searchlight system into minus 25° Fahrenheit (-32°C) low temperature chamber. The remote control box may be placed outside the low temperature chamber.
- 4.5.6.7.2 Maintain temperature at minus 25° Fahrenheit for 8 hours.
- 4.5.6.7.3 Test searchlight at minus 25° Fahrenheit per the requirements of 4.5.1, Starting and Normal Operation. Inspect for evidence of damage.
- 4.5.5.7.5 Record data.

DATE: 11/76

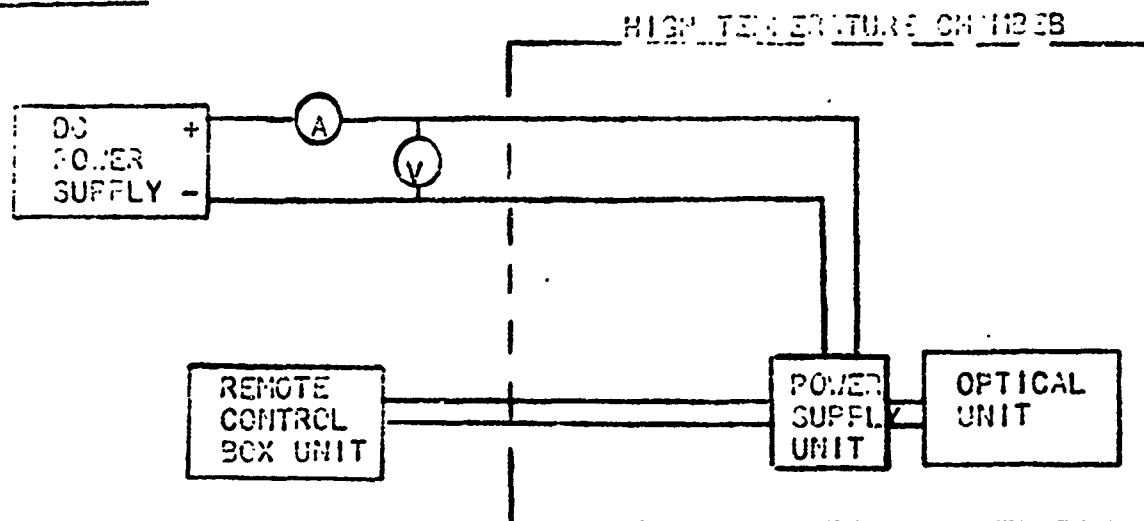
SERIAL NUMBER:

-23-

- 4.5.6 TEST HIGH TEMPERATURE OPERATION (RE: DAAK70-76-C-0270, 4.9)
- 4.5.6.1 TEST LOCATION Varian Environmental Test Lab.
- 4.5.6.2 TEST OBJECTIVE To determine if the Searchlight Set will start and then operate in all modes when maintained in a plus 130° Fahrenheit (+54°C) atmosphere.
- 4.5.6.3 REJECTION CRITERIA Failure to start and then operate per the requirements of 4.5.1, Starting and Normal Operation, or evidence of damage.
- 4.5.6.4 SPECIAL TEST CONDITIONS This test will be run at standard conditions, except that the temperature will be maintained at plus 130° Fahrenheit (+54°C).
- 4.5.6.5 TEST EQUIPMENT

EQUIPMENT	MINIMUM RANGE	ACCURACY
High Temperature Chamber with Recorder	75°F to 130°F	+3%
D.C. Power Supply	28 VDC, 60 A	N/A
Voltmeter	0 to 28 VDC	+3%
Ammeter	0 to 60 ADC	+3%

#### 4.5.6.6 TEST SETUP SCHEMATIC



#### 4.5.6.7 DETAIL TEST PROCEDURE

- 4.5.6.7.1 Place non-operating searchlight system into plus 130° Fahrenheit (+54°C) high temperature chamber. The remote control box may be placed outside the high temperature chamber.
- 4.5.6.7.2 Maintain temperature at plus 130° Fahrenheit for 8 hours with a relative humidity maintained between 90 and 98%.
- 4.5.6.7.3 Test searchlight at plus 130° Fahrenheit per the requirements of 4.5.1, Starting and Normal Operation. Inspect for evidence of damage.
- 4.5.6.7.4 Record data.

DATE: 11/76

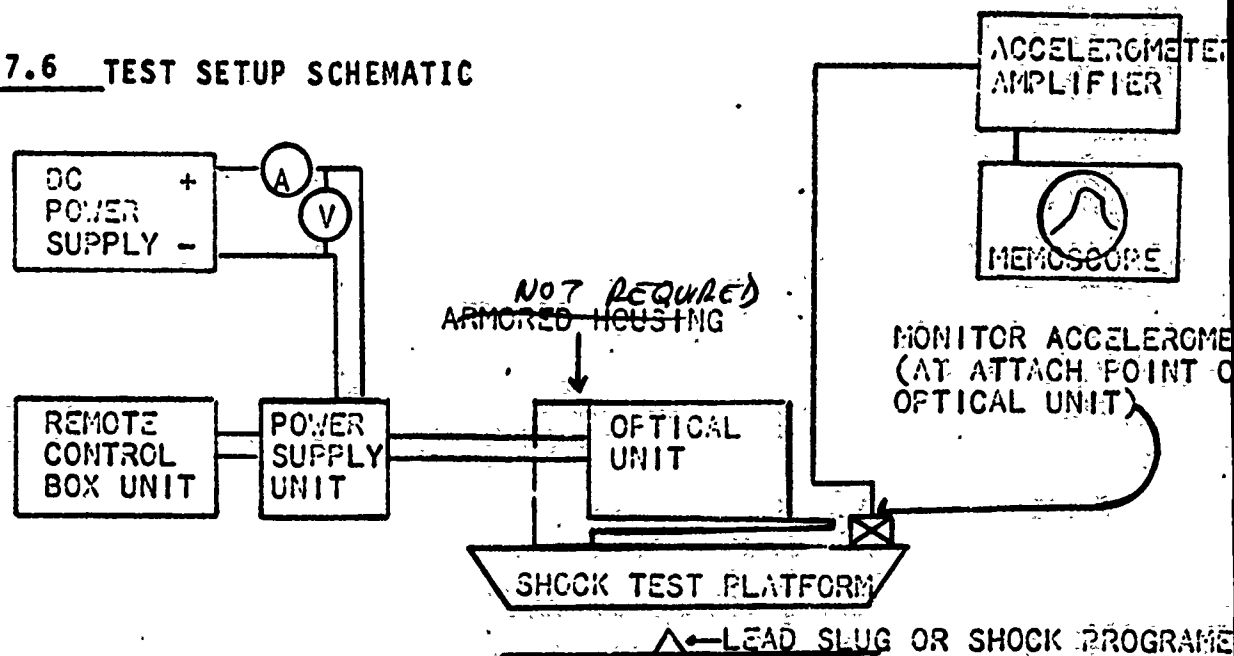
SERIAL NUMBER:

-26-

- 4.5.7 TEST SHOCK (RE: DAAK70-76-C-0270, 4.10)
- 4.5.7.1 TEST LOCATION Dalmo Victor Environmental Test Lab.
- 4.5.7.2 TEST OBJECTIVE To determine if the Searchlight Set will start and then operate following exposure of the optical unit (mounted in an armored housing) to mechanical shock when operating. *NOT REQUIRED*
- 4.5.7.3 REJECTION CRITERIA Failure following mechanical shock of the Searchlight Set to start and then operate per the requirements of 4.5.1, Starting and Normal Operation, or for the system to meet the requirements of 4.5.2, Beam Characteristics, or evidence of damage.
- 4.5.7.4 SPECIAL TEST CONDITIONS None.
- 4.5.7.5 TEST EQUIPMENT

EQUIPMENT	MINIMUM RANGE	ACCURACY
28 VDC Power Supply	0-28 VDC, 60 ADC	N/A
Shock Tester	0-450 G	N/A
Accelerometer with Amplifier	0-450 G	<u>+3%</u>
Oscilloscope (Memo type)	0-450 G	<u>+3%</u>
Shock & Vibration Fixture	N/A	N/A
Voltmeter	0 to 28 VDC	<u>+3%</u>
Ammeter	0 to 60 ADC	<u>+3%</u>

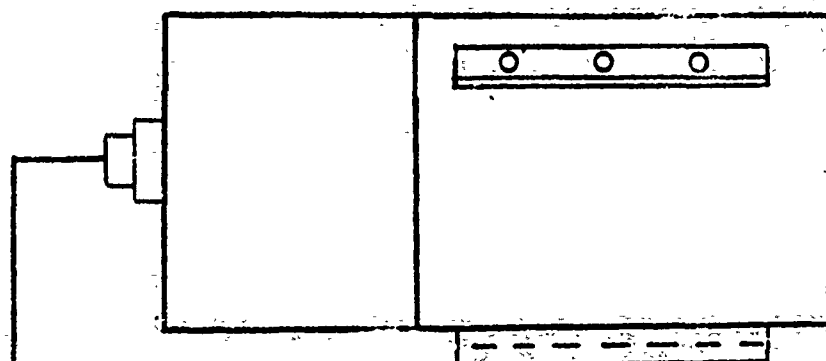
#### 4.5.7.6 TEST SETUP SCHEMATIC



#### 4.5.7.7 DETAIL TEST PROCEDURE

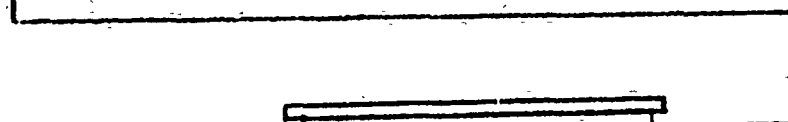
- 4.5.7.7.1 Mount the optical unit of the searchlight in the armored housing. Mount the armored housing for shock input in  $X_4$  axis. (See Figure 6).
- 4.5.7.7.2 Start and operate the searchlight in the compact, open and visible beam modes at 28 VDC.
- 4.5.7.7.3 Apply one (1) 450G shock, 1.0 milliseconds,  $\frac{1}{2}$  sine in the  $X_4$  direction.
- 4.5.7.7.4 Repeat 4.5.7.7.1 and 4.5.7.7.3, but in each of the  $X_1$ ,  $X_2$ ,  $X_3$ ,  $Y_1$  and  $Y_2$  directions (total of six (6) shocks).
- 4.5.7.7.5 Repeat 4.5.7.7.1 through 4.5.7.7.4, but with one (1) 40G, 18 milliseconds,  $\frac{1}{2}$  sine shock in each direction (total of six (6) shocks).
- 4.5.7.7.6 Test the searchlight per the requirements of 4.5.1, Starting and Normal Operation Test, and 4.5.2, Beam Characteristics Test (except operate searchlight for only 20 minutes prior to testing, Paragraph 4.5.2.7.2), and inspect for evidence of damage.
- 4.5.7.7.7 Record data.

DIRECTION	UNIT		
	OPTICAL	POWER SUPPLY	CONTROL BOX
VERTICAL	X2-X4	X2-X4	X2-X4
LATERAL	X1-X3	X1-X3	X1-X3
LONGITUDINAL	Y1-Y2	Y1-Y2	Y1-Y2



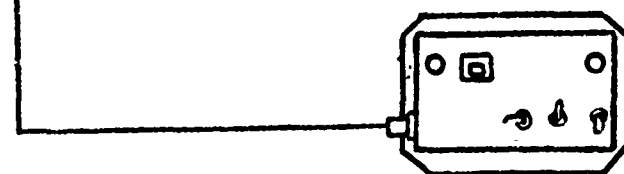
OPTICAL UNIT

17 FOOT CABLE



POWER SUPPLY UNIT

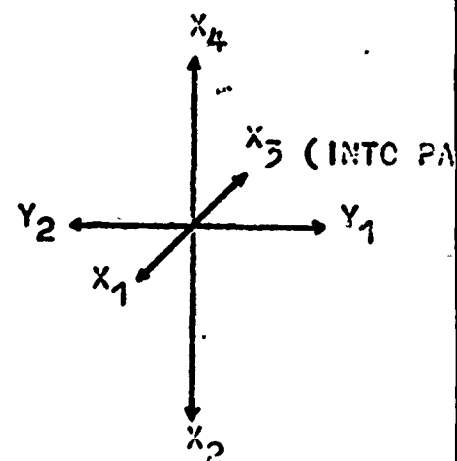
8 FOOT CABLE



REMOTE CONTROL BOX UNIT

SEARCHLIGHT SET  
(COORDINATE AXES)

FIGURE 6



**DATE:**

**SERIAL NUMBER:**

-29-

DATE: 11/76

**SERIAL NUMBER:**

-30-

**DATE:**

**SERIAL NUMBER:**

-31-

4.5.8 TEST VIBRATION (RE: DAAK70-76-C-0270, 4.11)

4.5.8.1 TEST LOCATION Dalmo Victor Environmental Test Laboratory

4.5.8.2 TEST OBJECTIVE To determine if the Searchlight Set will operate during, or if it's operating mechanisms are damaged when subjected to vibration.

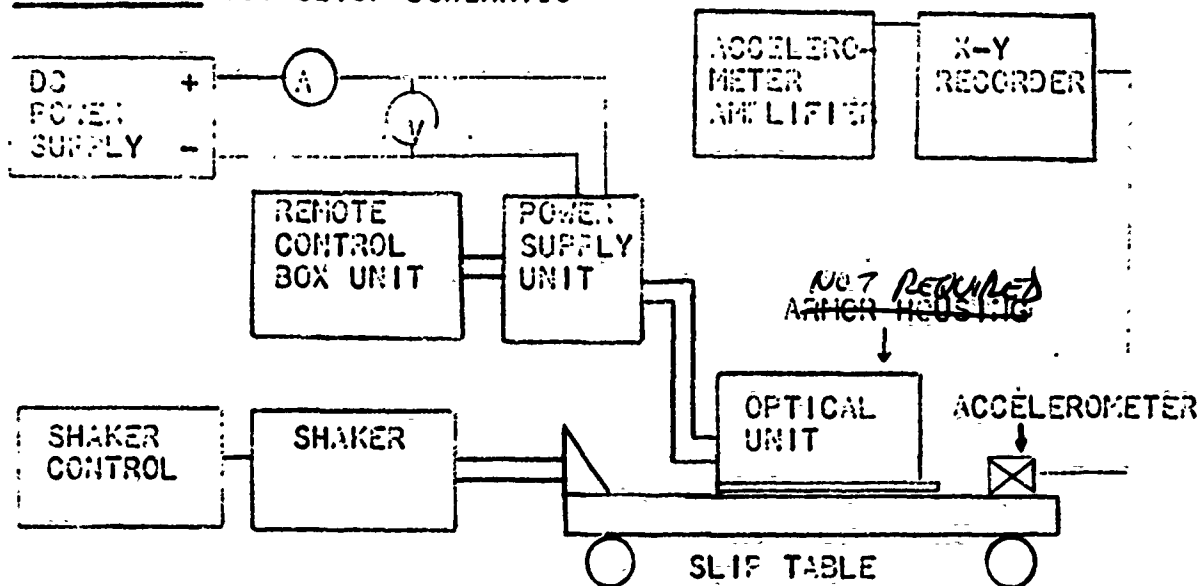
4.5.8.3 REJECTION CRITERIA Failure, following vibration, of the Searchlight Set to start and then operate per the requirements of 4.5.1, Starting and Normal Operation, or for the System to fail to meet the requirements of 4.5.2, Beam Characteristics.

4.5.8.4 SPECIAL TEST CONDITIONS None.

4.5.8.5 TEST EQUIPMENT

EQUIPMENT	MINIMUM RANGE	ACCURACY
D.C. Power Supply	28 VDC, 60 Amps	N/A
Shaker and Control	5-500 Hz	N/A
Accelerometer	5-500 Hz	±3%
Accelerometer Ampl.	5-500 Hz	±3%
Shock & Vibration Fixture	5-500 Hz	N/A
Voltmeter	0-28 VDC	±3%
Ammeter	0-60 ADC	±3%

#### 4.5.8.6 TEST SETUP SCHEMATIC



#### 4.5.8.7 DETAIL TEST PROCEDURE

- 4.5.8.7.1 Mount the optical unit of the searchlight in the armored housing. Mount the armored housing for vibration in Y<sub>1</sub>-Y<sub>2</sub> direction (See Figure 6).
- 4.5.8.7.2 Start and operate the searchlight in the Compact, Open and Visible modes at 28 VDC.
- 4.5.8.7.3 Vibrate the searchlight in accordance with the curve shown in Figure 7. Vibration frequency shall be a linear sweep for no less than one hour over the frequency range specified. The searchlight shall then be vibrated for a minimum of 5 minutes each at any resonant frequency conditions noted during the one hour sweep tests. If no resonant frequency is noted, then vibrate the searchlight at 14 Hz,  $\pm 2.5$  g for five (5) minutes.
- 4.5.8.7.4 Repeat 4.5.8.7.1 through 4.5.8.7.3 except mount the searchlight in the X<sub>1</sub>-X<sub>3</sub> direction.
- 4.5.8.7.5 Repeat 4.5.8.7.1 through 4.5.8.7.3 except mount the searchlight in the X<sub>2</sub>-X<sub>4</sub> direction.
- 4.5.8.7.6 Test the searchlight per the requirement of 4.5.1, Starting and Normal Operation Test and 4.5.2, Beam Characteristics test (except operate the searchlight for only 20 minutes prior to resting, para. 4.5.2.7.2). Inspect for evidence of damage.
- 4.5.8.7.7 Record data.

○ ○

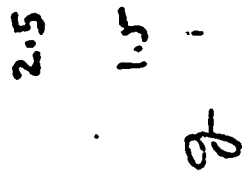


FIGURE 2

**DATE:**

**SERIAL NUMBER:**

-34-

DATE: 11/76

**SERIAL NUMBER:**

-35-

DATE:

SERIAL NUMBER:

- 36 -

## 5.0 TEST REPORT

After completion of the Quality Assurance tests, a formal test report will be submitted summarizing all results and discussing pertinent observations. This report will be submitted within thirty days following completion of testing.

## APPENDIX

- A) Sample Test Equipment List
- B) Sample Daily Log Sheet
- C) Sample Test Data Summary Sheet





## TEST DATA SUMMARY SHEET

**TEST NUMBERS**

[illegible]

**APPENDIX II**  
**SHOCK TEST REPORT**

**DALMO VICTOR**  
Division of Textron, Inc.

1515 Industrial Way

Belmont, California 94002

Phone: 591-1414

**ENVIRONMENTAL TEST LABORATORY**

**FLASH REPORT**

Date	TR No.	Project	Account No.	Task No.	Test Engineer
11 Feb 77	3275	EIMAC	B 864	149	AJC&PP
Part Number		Serial Number		Environment	
-----		-----		Mech. shock	
Specimen			Start Date		Completion Date
Search light set			7 Feb 77		9 Feb 77
Test Authorization and Specification			Approval		Date
EIMAC DAAK70-76-c-0270			<i>[Signature]</i>		<u>11 Feb 77</u>
			R. Pershing		
			<i>[Signature]</i>		<u>11 Feb 77</u>
			A. J. Czapowski		
<b>Test Objectives:</b> To verify the ability of the Search light to withstand mechanical shock.					
<b>Test Procedures:</b> EIMAC# DAAK70-76-C-0270 A. 450g @ 1.0msec 1/2sine- one shock in each of six axis. B. 40g @ 18msec 1/2sine- one shock in each of six axis.					
<b>Test Results:</b> The unit was subjected to the required shock environment. All performance data was retained by EIMAC.					
<b>Remarks:</b>					

## ENVIRONMENTAL TEST LOG

TEST SPECIMEN SEARCH-LIGHT-SETP M SERIAL NUMBER -TEST PROCEDURE E. DAK 70-74 ISSUE PROJECT NUMBER -TEST TITLE C-0270 TR NUMBER 3275 DATE 8 FEB 77  
3400/sACCOUNT NUMBER B76V-149 PROJECT EIMAC ENVIRONMENT SMOKE

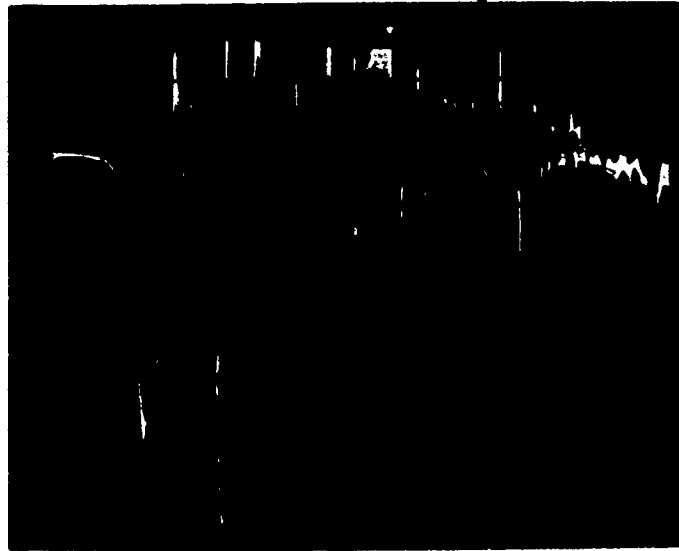
PARA	START	END	COMMENTS	INITIALS	DATE
	1030		Set up for 450 G ± .9 M. SEC. SINE PULSE	AJC	8 FEB 77
	1130		INSTALL LIGHT IN FURNACE		
	1340		LIGHT IN X 4 AXIS + DROP # 1		
	1430		" # 2	AJC	8 FEB 77
	1515		Set up for 40 G ± - 200 MS		
			Set up in X 4 AXIS		
	1600		DROP # 3	AJC	8 FEB 77
	1735		Set up for X 4 AXIS (+)	AJC	8 FEB 77
	1750		DROP # 4		
	1755		Set up for X 2 AXIS (-)		
	1835		DROP # 5		
			Set up for X 3 AXIS (+)		
			PHOTO of TEST SET		
	1115		DROP # 6		
			Set up for X 1 AXIS (+) (-)		
			PHOTO		
			DROP # 7		
	1230		Set up for Y-2 AXIS	AJC	8 FEB 77
			PHOTO		
			DROP # 8		

# ENVIRONMENTAL TEST LOG

TEST SPECIMEN \_\_\_\_\_ P N \_\_\_\_\_ SERIAL NUMBER \_\_\_\_\_  
 TEST PROCEDURE \_\_\_\_\_ ISSUE \_\_\_\_\_ PROJECT NUMBER \_\_\_\_\_  
 TEST TITLE \_\_\_\_\_ TR NUMBER 3275 DATE 9 FEB 77  
 ACCOUNT NUMBER B864-149 PROJECT E/MAC ENVIRONMENT SMACK

PARA.	START	END	COMMENTS	INITIALS	DATE
1425			Set up for Y-1 AXIS CALIB. DROP.	AKC	9 FEB 77
1515			PHOTO of Set up DROP # 9		
1530			Set up for 450 g's - .94 sec PHOTO of TEST Set up DROP # 10 Y-1 AXIS	AKC	9 FEB 77
1605			Set up for Y-2 AXIS		
1615			DROP # 11		
			Set up for X-2 AXIS		
			DROP # 12		
			Set up for X 1 AXIS		
			DROP # 13		
1700			Set up for X 3 AXIS	AKC	9 FEB 77
			DROP # 14		
0800			Remove fixture from back Mach., complete Repair	AKC	11 FEB

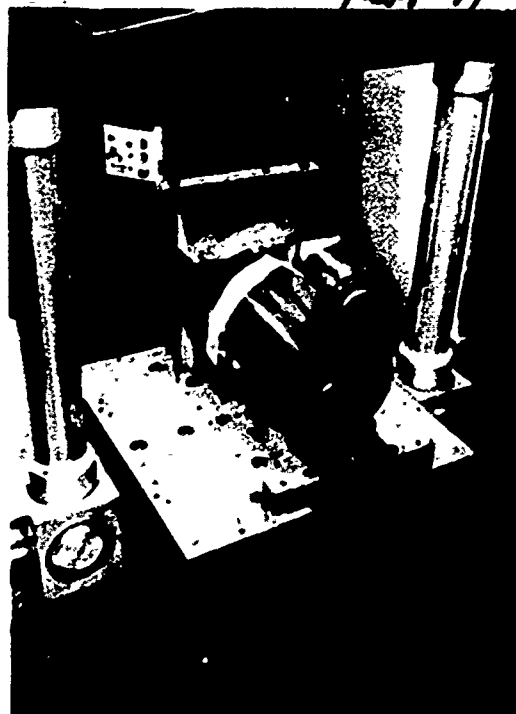
8 FEB 77



ORANGE 1

X 4 AXIS

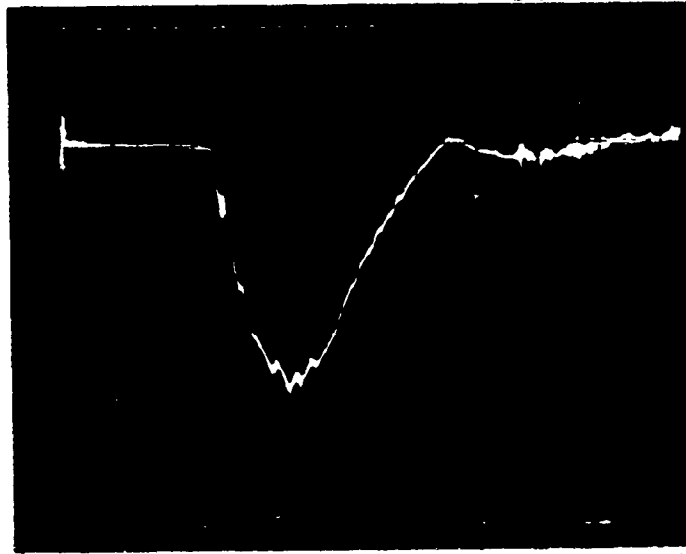
7-26-8-77



X 4 AXIS

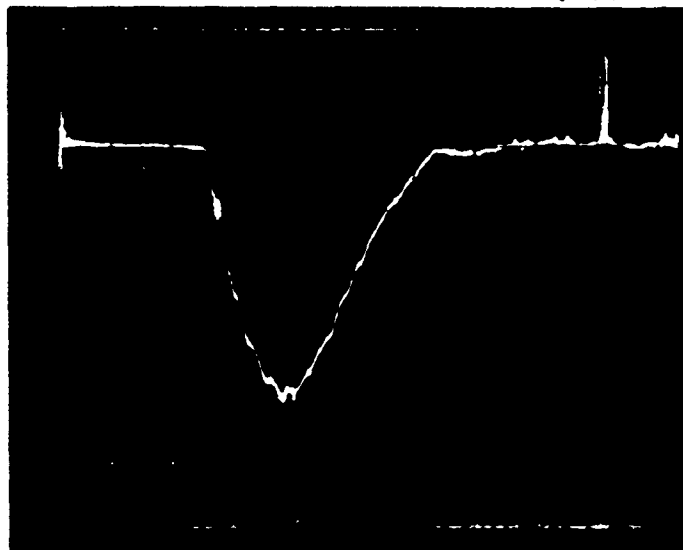
ORANGE 1

8 FEB 77

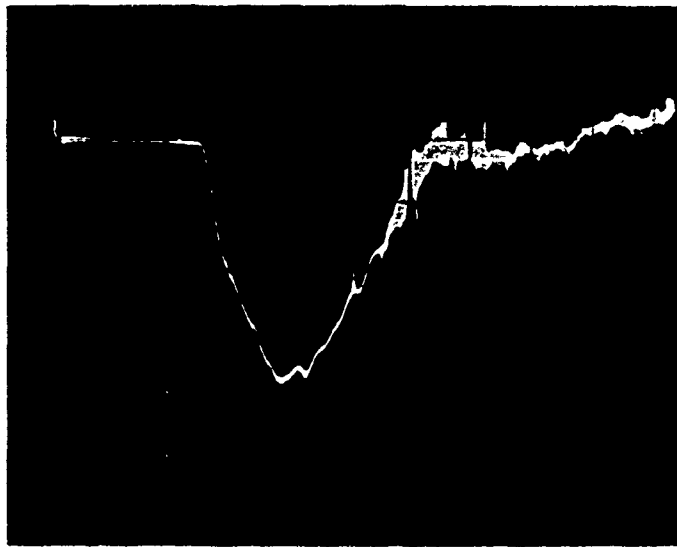


4092 204Sec URGENT X4A15

9 Feb 77

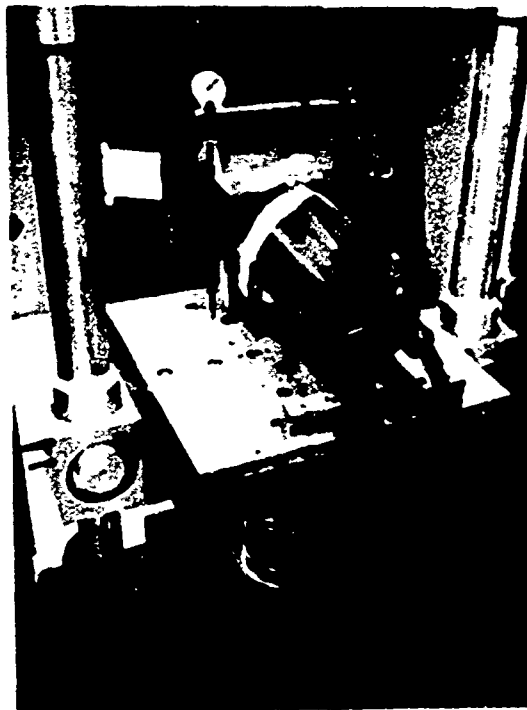


50's/010 5M SEC/010 (C) 11/11



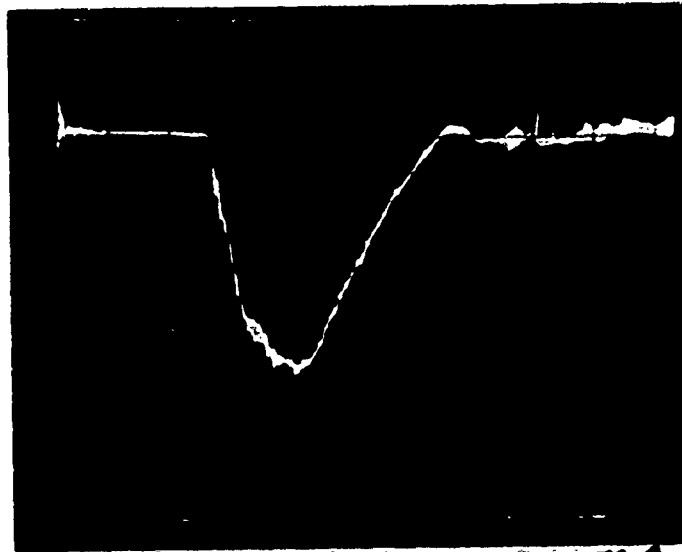
X 2 AXIS

DRP# 5



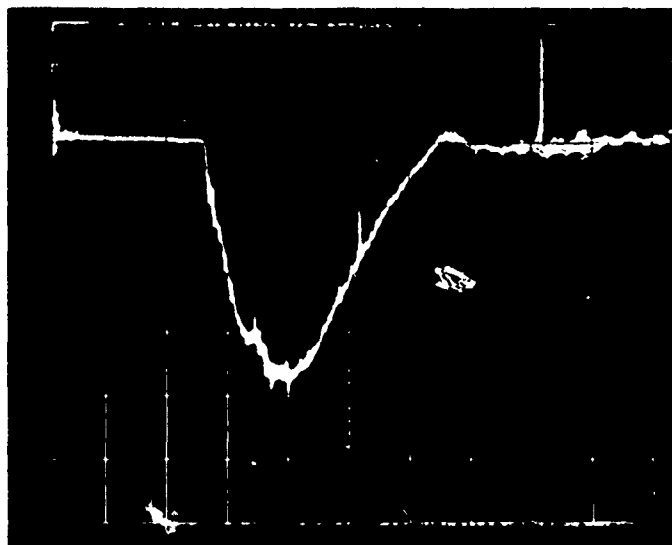
X 2 AXIS

DRP# 5



X 3 AXIS

DRAPM 6



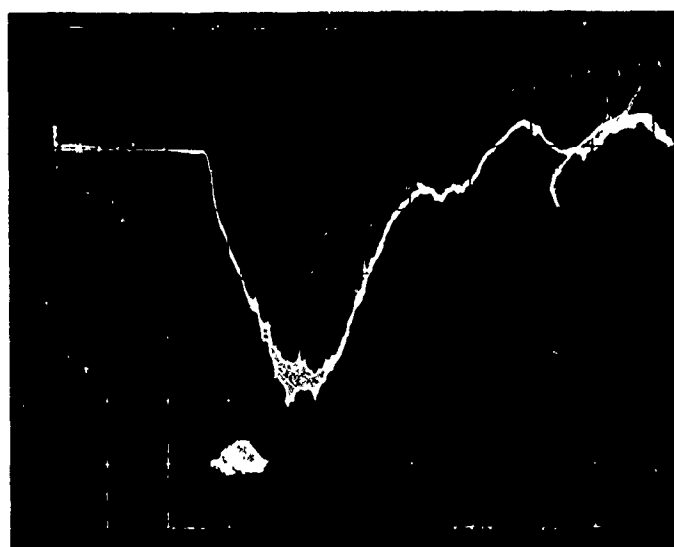
X1 AXIS

DROP #7



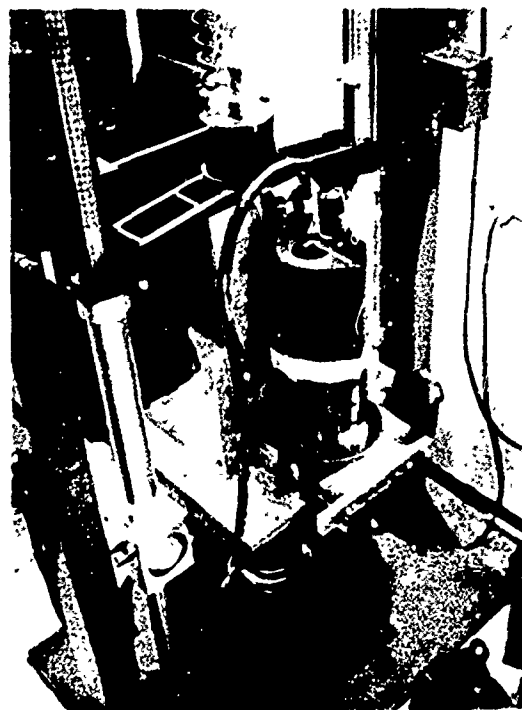
X1 AXIS

DROP #7



Y 2 AXIS

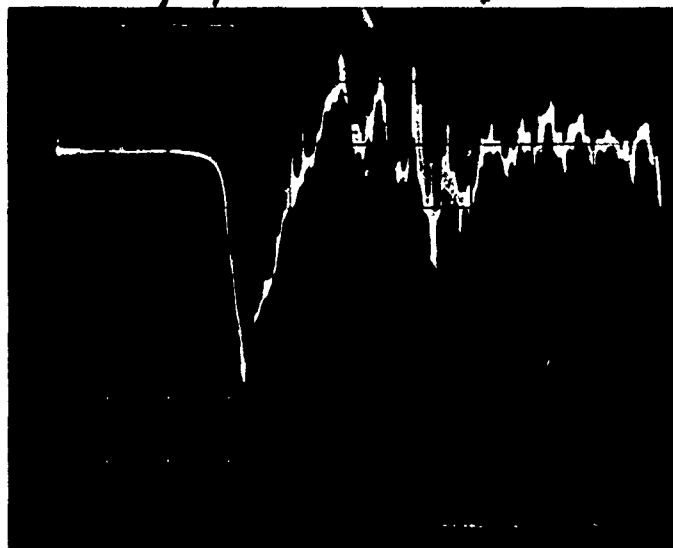
DROPP 8



Y 2 AXIS

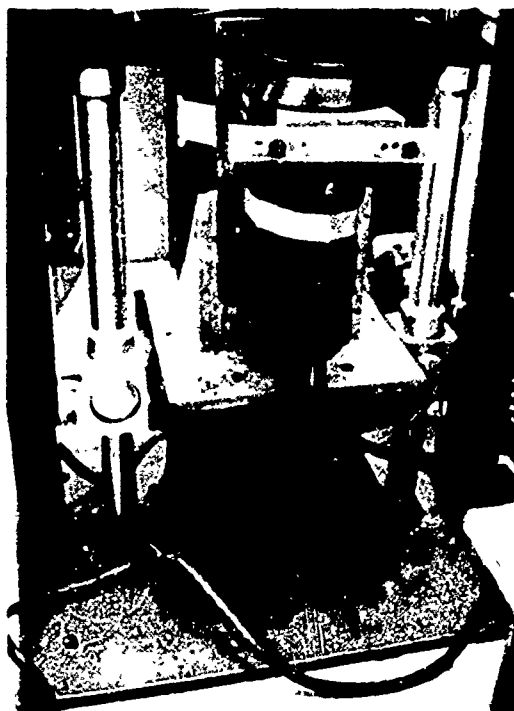
DROPP 8

100 g's / DIV 1 M SEC / DIV.



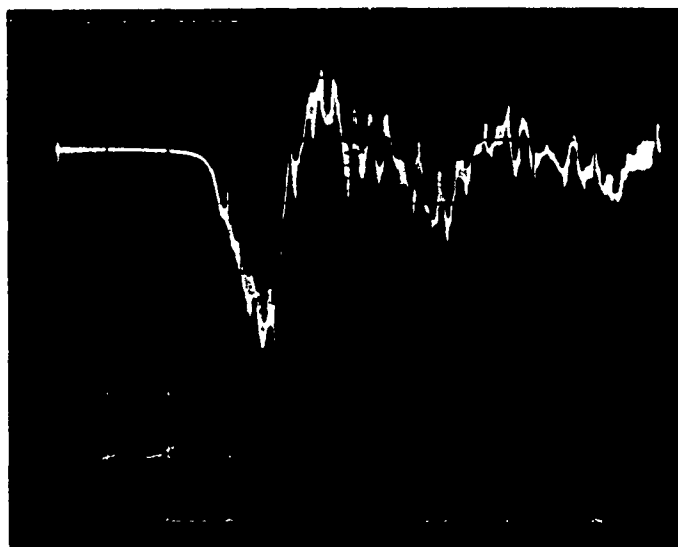
Y 1 AXIS

DROP # 10



Y-1 AXIS

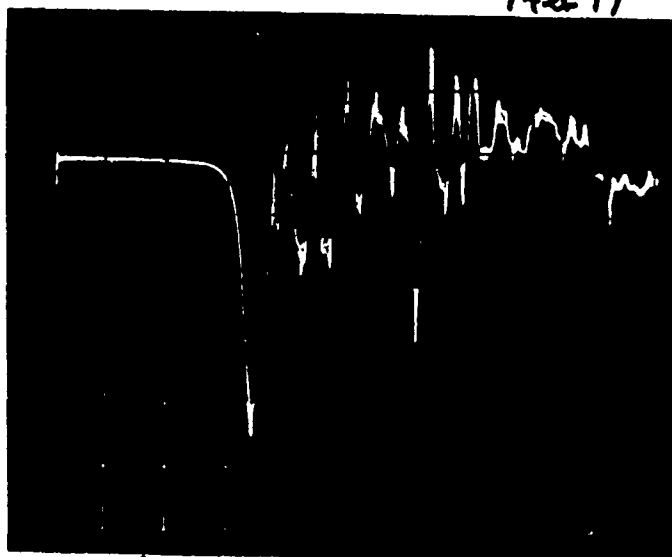
DROP # 10



Y-2 AXIS

DROPP#11

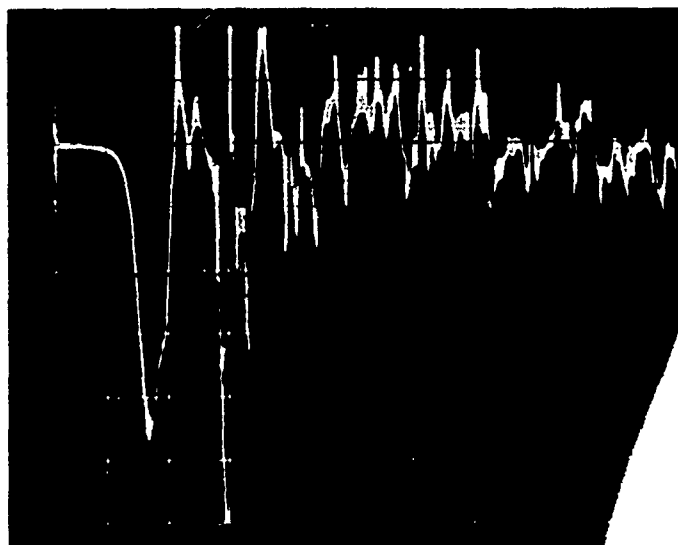
972277



X1 AXIS

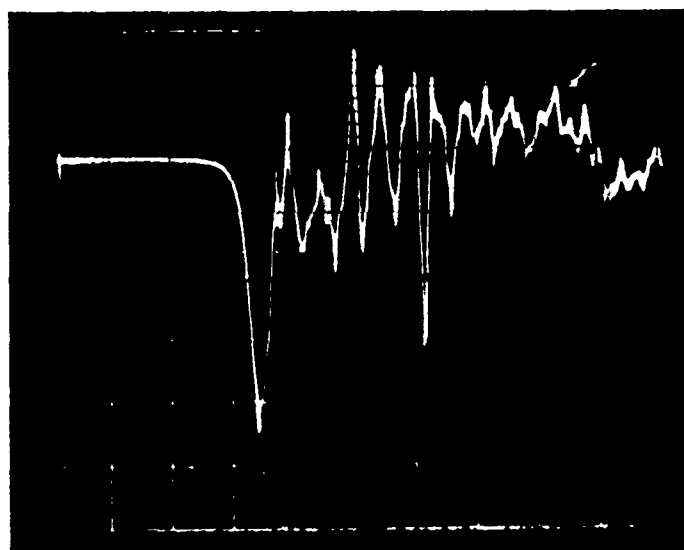
450 GS

DROPP#13



100 G's 14 sec/div

LIGHT #2



X 3 AXIS

450 G's

DROP #4

APPENDIX III  
ELECTROMAGNETIC INTERFERENCE TEST MEMO

August 30, 1976

MEMO TO: File

FROM: Gordon Lavering

SUBJECT: Armored Illuminator - Electromagnetic Interference

A prototype 1kW xenon searchlight was designed, assembled, tested and delivered to the U.S. Army's Night Vision Laboratory. The work was done under contract DAAG53-76-C-0005. The searchlight is referred to as the Armored Illuminator.

In the final report submitted under that contract it was reported that the searchlight met all but two of the electromagnetic interference (E.M.I.) tests required under quality assurance testing. These were MIL-STD-461, Notice 4; Conducted Emissions, Broadband and RE02, Radiated Emissions, Broadband.

Analyses of the original E.M.I. data indicated that the test failures all occurred at high frequencies, mostly above 1MHz, and with a predominant noise peak near 10MHz. This noise was recently determined to have been caused by a 28 VDC/115VAC inverter unit which is used to supply power for the searchlight's cooling fan. High frequency line filtering was added to the inverter circuit. E.M.I. testing was again conducted. The searchlight with the new circuit passed the two tests previously failed.

The searchlight is now rated as capable of passing all of the MIL-STD-461A and 462 test requirements originally required in contract DAAG53-76-C-0005.

The original inverter/fan circuit is shown in Figure A. The only change made in this original circuit is the addition of the two .03 $\mu$ f capacitors (with the shortest leads possible) as shown dotted-in in Figure A.

The test plan called for E.M.I. testing of the armored illuminator with the two .03 $\mu$ f capacitors included in the inverter circuit. The capacitors were to then be removed and retesting was to be done. During installation of the two capacitors in the searchlight however, the original inverter was damaged (a positive lead wire was shorted to ground). A second, new inverter was installed with the two capacitors and testing proceeded. Following these tests, the two capacitors were removed and the tests were repeated.

Figure B shows the original (failing) CE04 conducted emissions, broadband test data. Two sets of data are shown in this Figure; one set is for the +28V lead and the other is for the -28V lead. The failure is maximum around 10MHz.

Figures C and D show the CE04 data taken with the new inverter installed. Figure C shows the data taken on the +28V lead, both with and without the two .03 $\mu$ f capacitors included. Interestingly, the two capacitors greatly reduce the E.M.I. noise, however, the searchlight with the new inverter, but with no .03 $\mu$ f capacitors, would have passed this E.M.I. test. Similar data are shown for the -28V lead in Figure D.

Figure E shows the original (failing) RE02, radiated broadband emissions data. Note the predominant E.M.I. noise occurs near 10MHz.

Figure F shows the radiated emissions data taken with the new inverter and without the two .03 $\mu$ f capacitors. Figure G shows the effects on the radiated noise by the addition of the capacitors. Some attention is noted.

The conclusions drawn from these tests are:

- 1) The searchlight with the original inverter and with the addition of the two .03 $\mu$ f capacitors may have passed all of the required E.M.I. tests.

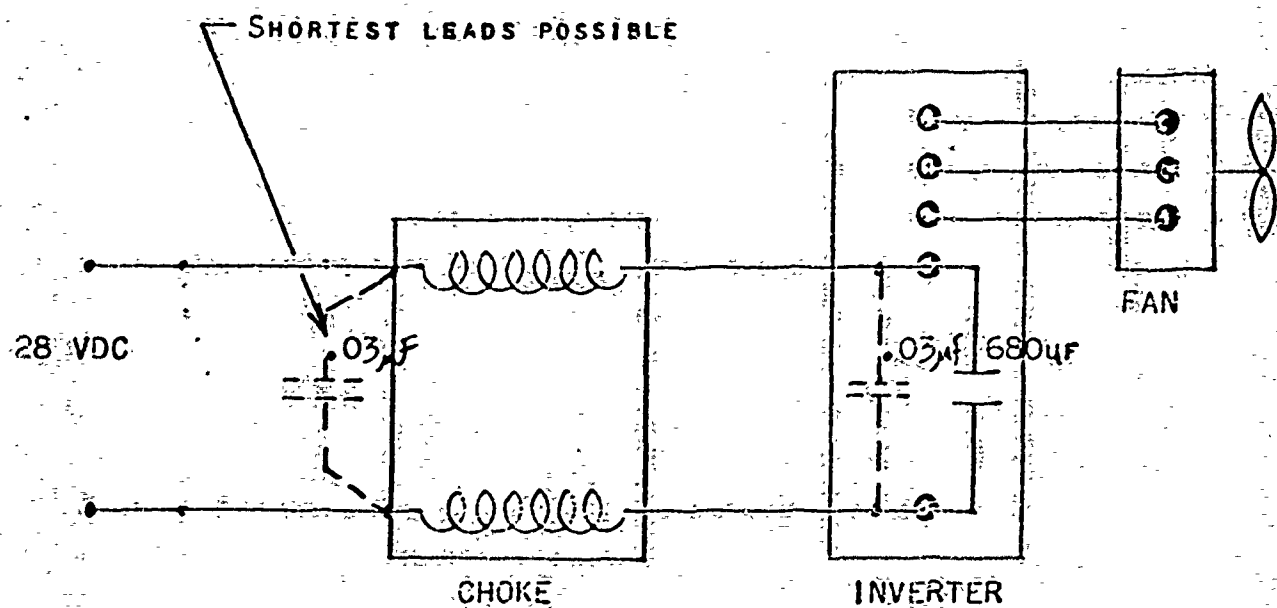
- 2) The searchlight with the new inverter would have passed all of the required E.M.I. tests.
- 3) The searchlight with the new inverter and with the two .03 $\mu$ f capacitors will pass all of the required E.M.I. tests.
- 4) The original inverter may have had a faulty component which caused the E.M.I. interference.

EIMAC intends to now inspect all inverters for noise, using a test circuit developed here, prior to installing them in any future searchlights built. The two .03 $\mu$ f capacitors will also be included in the inverter circuit in all future searchlights.

The commercial data taken for this test report are on file at EIMAC

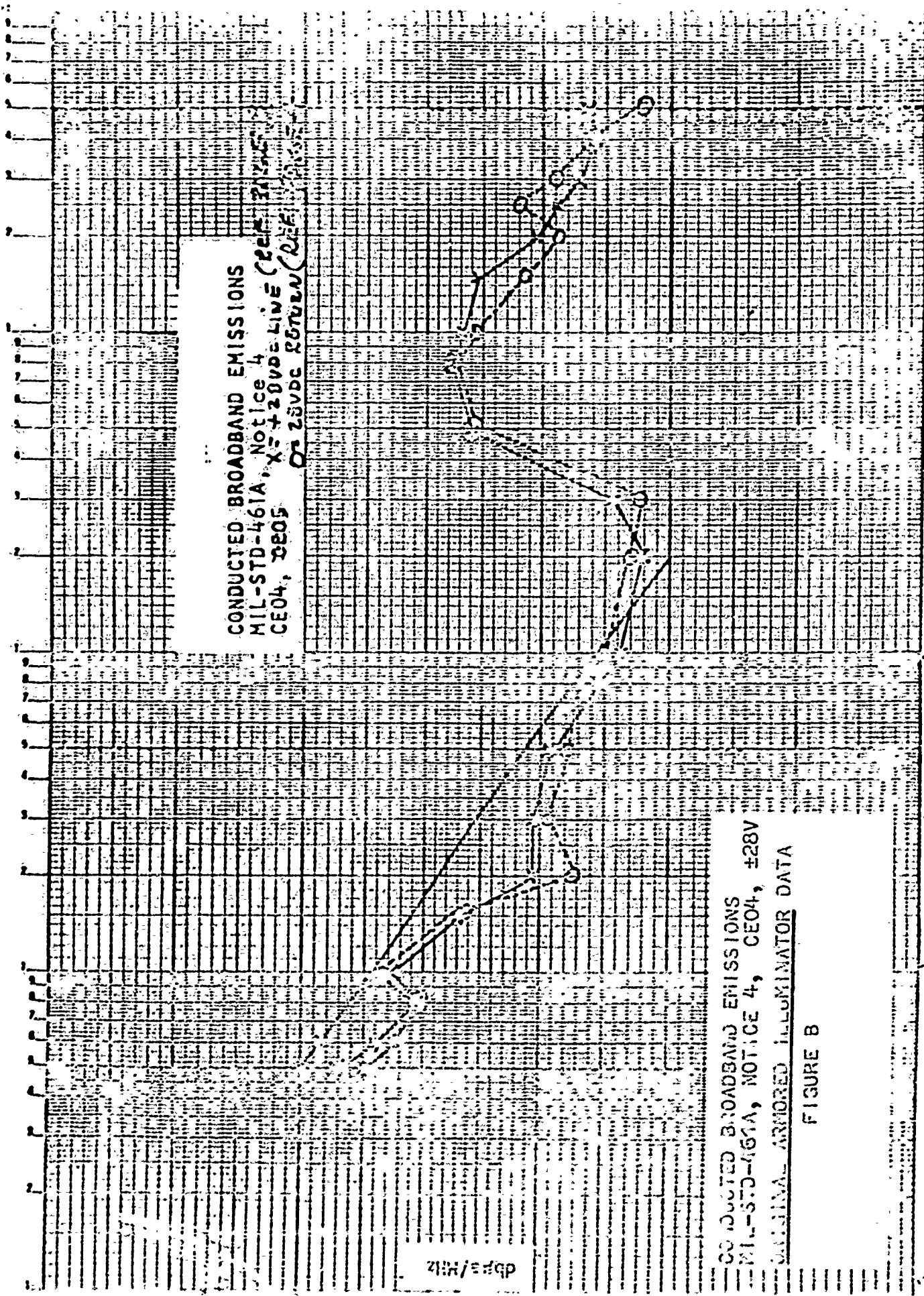
cc: F. Knopp, D. Wilson, B. Faust, G. Valier, A. Pohlmeier

nm



NOTE: THE TWO  $.03\mu F$  CAPACITORS WERE NOT INCLUDED IN THE ORIGINAL SEARCHLIGHT'S INVERTER CIRCUIT.

FIGURE A



CONDUCTED BROADBAND EMISSIONS  
MIL-STD-461A, NOTICE 4, CE04, ±28V  
ORIGINAL ARMORED ILLUMINATOR DATA

FIGURE B

BYPASS CAPS REMOVED

CONDUCTED BROADBAND EMISSIONS  
MIL-STD-461A, NOTICE 4  
CE04, CE05, +28VDC

CONDUCTED BROADBAND EMISSIONS  
MIL-STD-461A, NOTICE 4, CE04, +28V  
CONDUCTED BROADBAND EMISSIONS  
MIL-STD-461A, NOTICE 4, CE04, +28V

FIGURE C

100.00 pF CAPACITORS  
100.00 pF CAPACITORS

FREQUENCY - MHz

100

W B BYPASS CAPS REMOVED

CONDUCTED BROADBAND EMISSIONS  
MIL-STD-461A, Notice 4  
CE04, CE05 -28 VDC

CONDUCTED BROADBAND EMISSIONS  
MIL-STD-461A, NOTICE 4, CE04, -28V  
MIL-STD-461A, NOTICE 4, CE05, -28V

FIGURE 3

— 100.00000 CAPACITORS  
— 100.00000 CAPACITORS

FREQUENCY - MHz

100

10

1

RADIATED BROADBAND EMISSIONS  
MIL-STD-461A, Notice 4  
(RE02)

RADIATED BROADBAND EMISSIONS  
MIL-STD-461A, NOTICE 4, RE02,  
UNCORRECTED ILLUMINATOR DATA

FIGURE E

FREQUENCY - MHz

10.

100.

1,000.

dBm/MHz

YE SEMI-LOGARITHMIC 40 0213  
 5000 1000 500 200 100 50 20 10 5 2 1 0.5 0.2 0.1

BYPASS CAPS REMOVED

RADIATED BROADBAND EMISSIONS  
 MIL-STD-461A, NOTICE 1 & 4  
 (RE02)

dBuV/M/KHz

RADIATED BROADBAND EMISSIONS  
 MIL-STD-461A, NOTICE 1 & 4, RE02  
 DATA TO DERIVED ILLUMINATOR DATA

FIGURE F

19.00 pF CAPACITORS

FREQUENCY - MHz

100 1,000

# **RADIATED BROADBAND EMISSIONS** **MIL-STD-461A, Notice 1 & 4** **(RE02)**

**RADIATED BROADBAND EMISSIONS**  
**MIL-STD-461A, NOTICE 1 & 4, RE02**  
**ILLUMINATOR DATA**

**FIGURE G**

**750 .05µF CAPACITORS**

10 100 1,000  
 FREQUENCY - MHZ